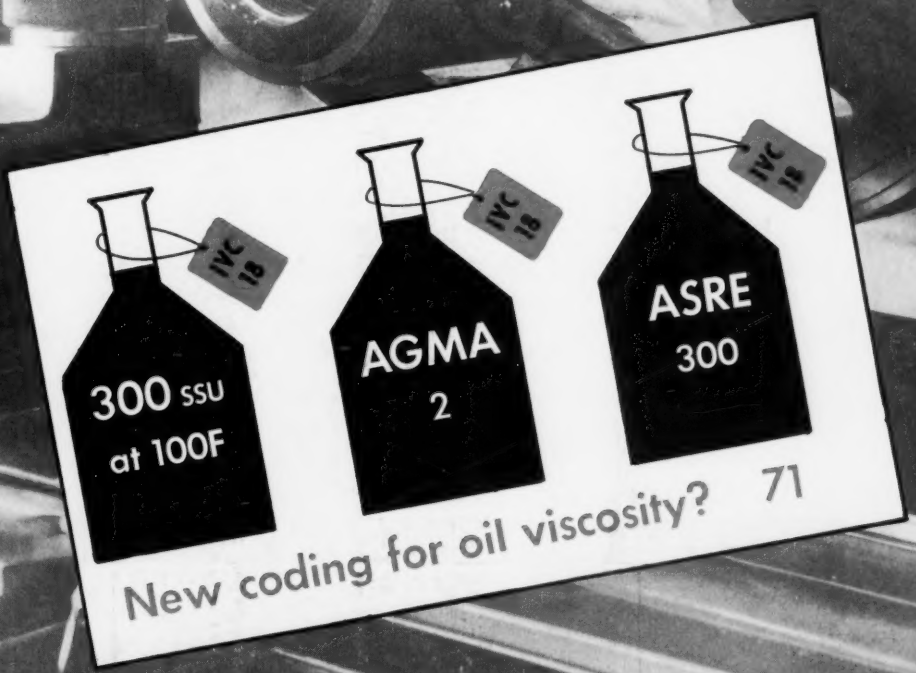
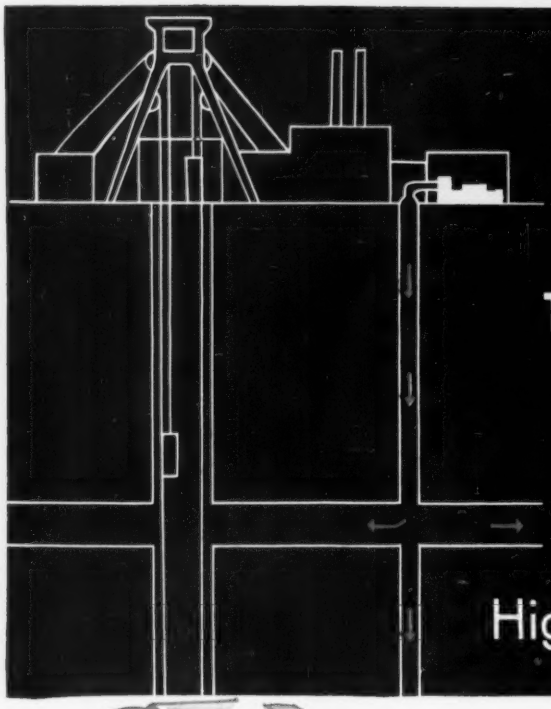
75th Year of advancing the power services

# Power

AUGUST 1957
ONE DOLLAR
A McGRAW-HILL PUBLICATION



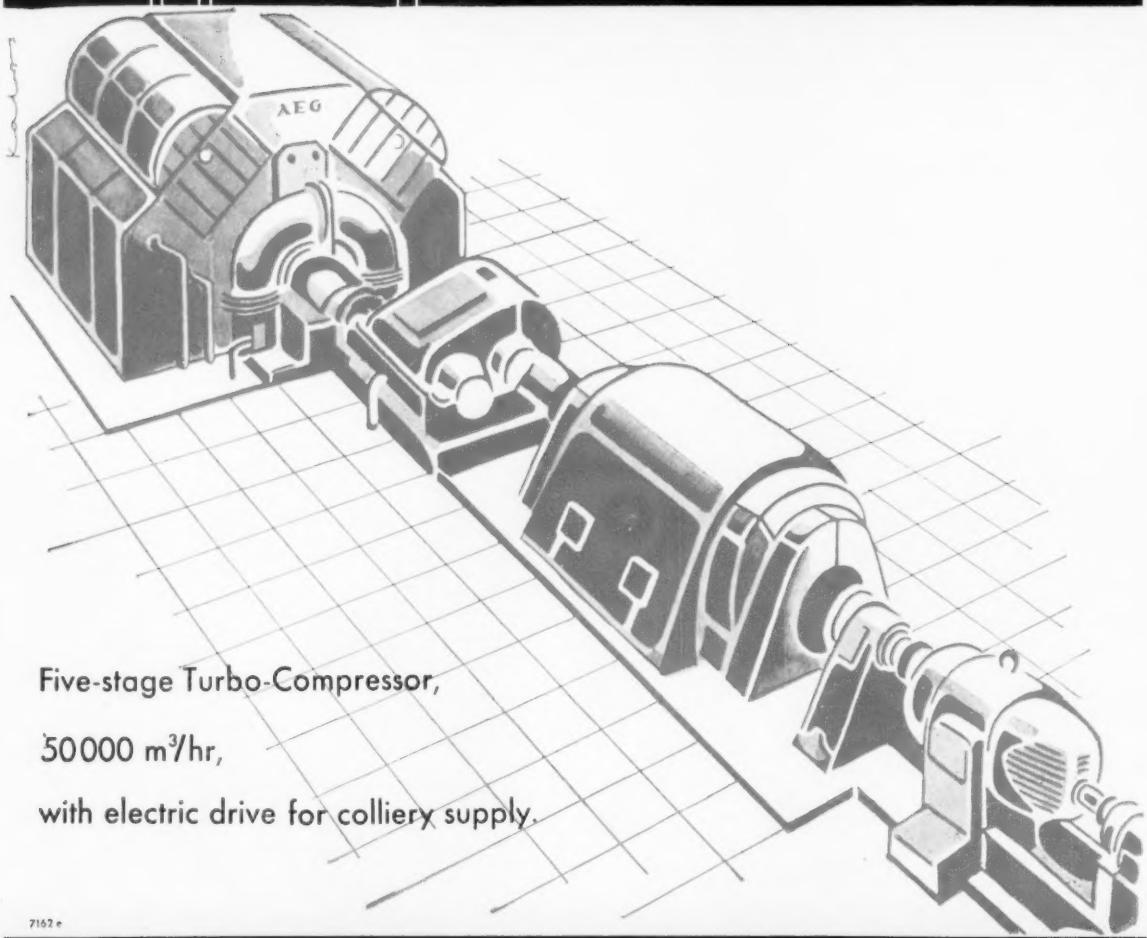

New coding for oil viscosity? 71



# AEG

## Turbo-Compressors in Mining

## High Isothermal Efficiency




Five-stage Turbo-Compressor,

50000 m³/hr,

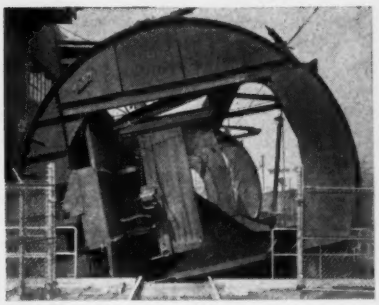
with electric drive for colliery supply.

7162 e

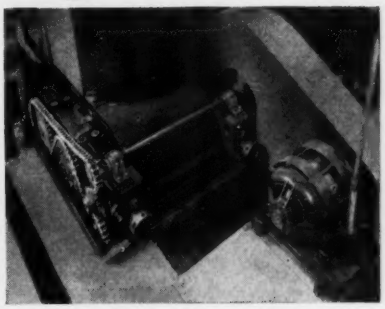
**ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT**

Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)

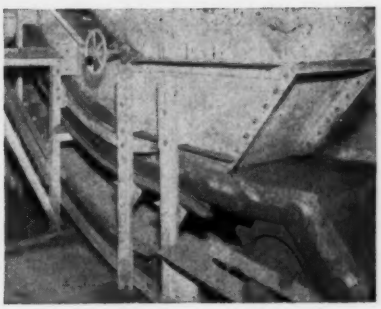
# For all sizes of power plants--



**ROTARY DUMPERS** unload gondola cars in 90 seconds or less (including return to upright position). Handle all types of open-top cars up to 90-ton capacity.

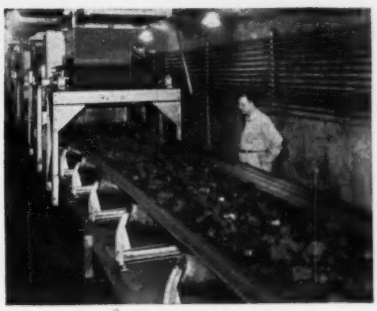


**COAL CRUSHERS** provide means for crushing run-of-mine coal. Can be furnished in single-roll or two-roll types for producing an accurately sized, uniform product.

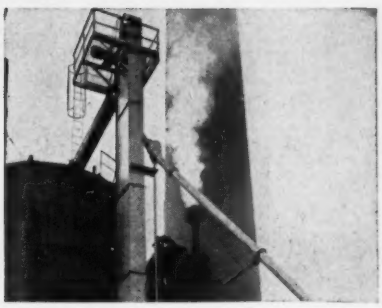


**APRON FEEDERS** move coal horizontally or on inclines up to 25° from hoppers or bins in continuous, uniform flow. Rugged overlapping pans resist impact.

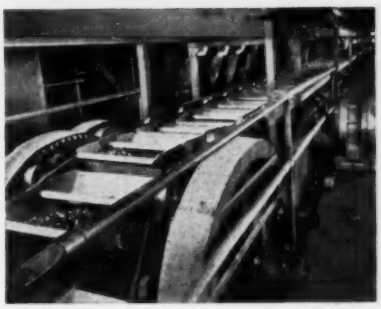
# LINK-BELT equipment and engineering...



**BELT CONVEYORS** handle large tonnages at low cost—stock out, reclaim, distribute. Link-Belt also builds all types of idlers, terminal machinery, trippers, etc.

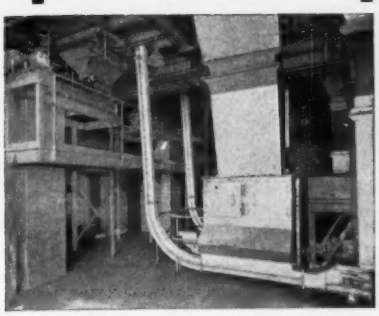


**BUCKET ELEVATORS** offer flexible, low-cost handling. Link-Belt elevator shown discharges to silo and also handles coal to and from reserve ground storage.

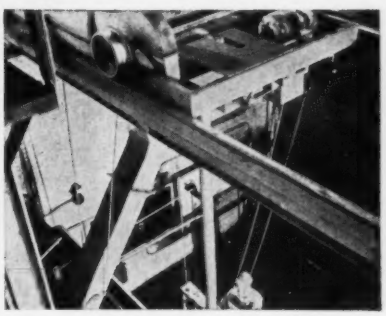


**PECK CARRIERS,** used in many coal handling systems for the last 60 years, elevate and convey coal in a continuous flow without the need for transfers.

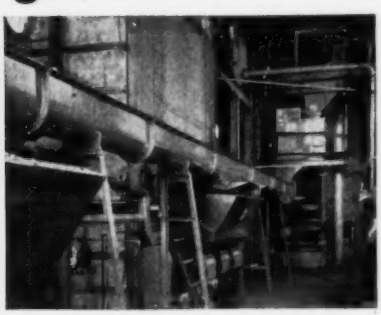
# spell lowest per-ton handling costs



**BULK-FLO** combines functions of conveyor, elevator and feeder in a single unit of high capacity. Above, coal is delivered to crusher for continuous sampling.



**WEIGH LARRIES** automatically weigh and record amount of coal delivered to each stoker or bunker. Link-Belt offers motor or hand-propelled types in all sizes.



**SCREW CONVEYORS** provide economical distribution of coal to stoker hoppers. Link-Belt can supply all components—screws, troughs, hangers, drives, etc.

You'll be interested in Book 2410. Its 44 pages of photographs and drawings include many outstanding Link-Belt coal handling systems, large and small. Your nearest Link-Belt office has your copy.

**LINK-BELT**

**COAL HANDLING EQUIPMENT**

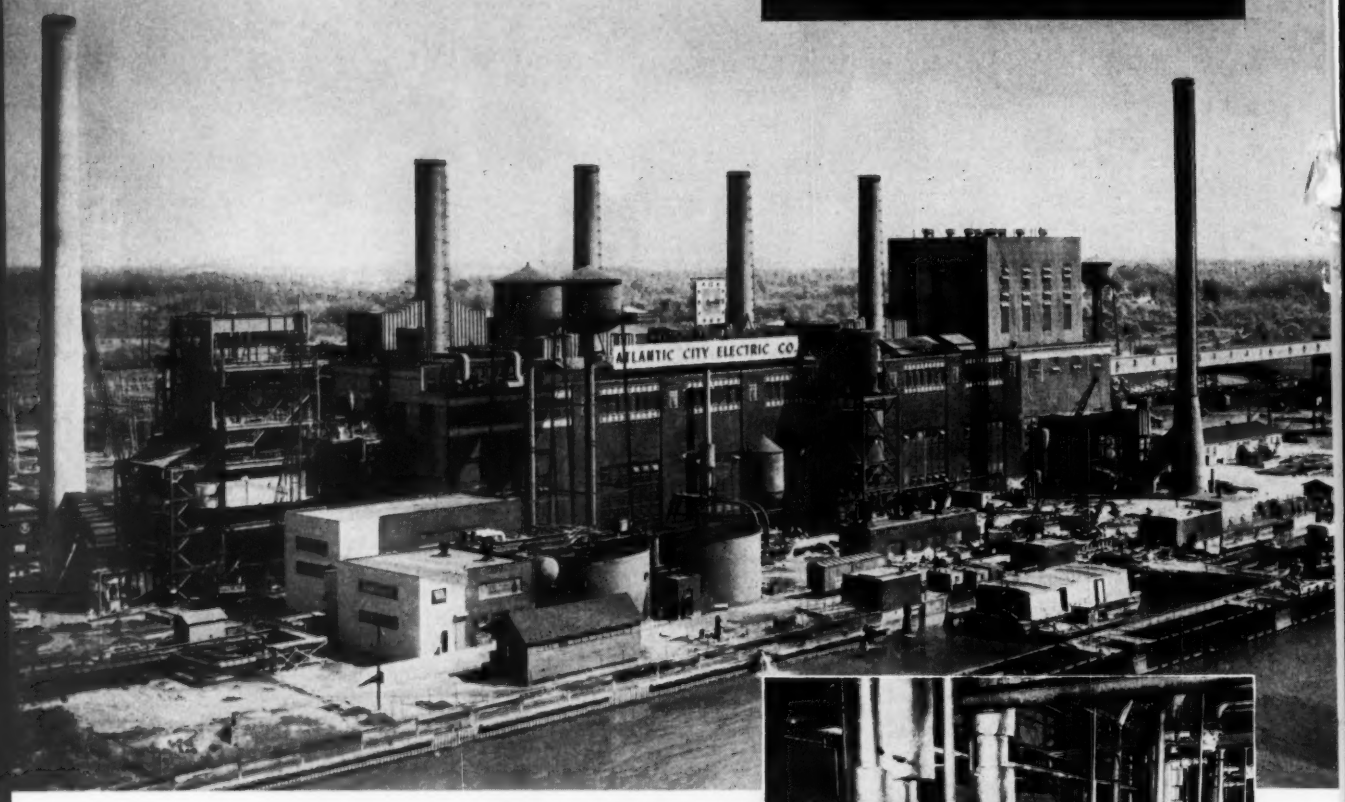
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

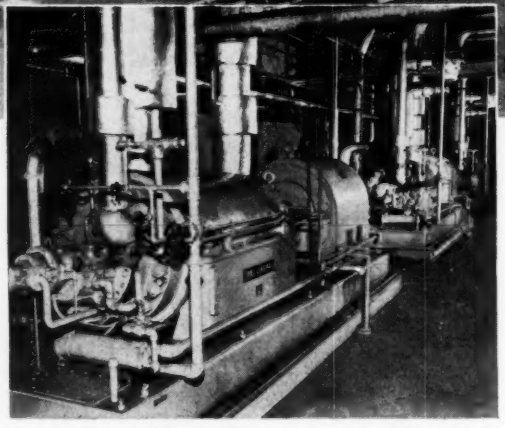
14 227

# *Modern central stations use*

# DE LAVAL

## BARREL TYPE BOILER FEED PUMPS



Three ten-stage De Laval high pressure, barrel type boiler feed pumps, are on the line at the Deepwater Station of the Atlantic City Electric Company. Shown above is an aerial view of this station located in Penns Grove, New Jersey at the southern end of the Jersey Turnpike. Each pump delivers 675 gpm to the boiler for a total flow of 685,000 pounds per hour. Each pump operates at 1762 psi with temperature at 287 F., and is driven by a 900 hp motor.

When it came time to modernize one of their existing facilities, Atlantic City Electric Company and Gibbs & Hill, Inc., consulting engineers, chose two similar De Laval pumps to serve a new 79,000 kw generator.

**IMO Pumps For Fuel Oil Service**

Also doing an important job in this Atlantic City Electric Company station are De Laval IMO screw-type positive displacement pumps. They supply fuel oil to the burners round the clock.

*Send for De Laval Bulletin 1506, which contains helpful data.*

**DE LAVAL** *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

*815 Nottingham Way, Trenton 2, New Jersey*

DL-386

# Power

AUGUST 1957 • VOLUME 101 NUMBER 8

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**Print order this issue: 49,722**

**VISCOSITY** is generally the most important single physical property engineers concern themselves with in dealing with lubricants. But, in the minds of many, the problem is unnecessarily complicated by the variety of ways for specifying this key property.

A viscosity classification system that would hold for all industrial lubricating oils is in the wind, as this month's cover suggests. Adoption of such a scheme presents new problems for oil marketers, could well affect your lube-purchasing habits. Thus you'll want to read the staff report on this development that starts on p 71.

### *Next month . . .*

September, of course, brings POWER's 75th anniversary issue, the biggest—and most significant, we believe—in our long history. For an indication of why we feel this way, see p 98.

### *. . . and future months*

As feeder and distribution systems grow, short-circuit amps soar. How to group in-plant components to cut the available currents to a size that can be handled is the subject of a timely article coming up in the PTG series.

This year's edition of POWER's *Modern Plant Survey* will appear in December. As usual, it will have tabulated data on technical features of new steam central stations, industrial plants and hydro electric installations, plus graphical summaries of trends in today's plants.




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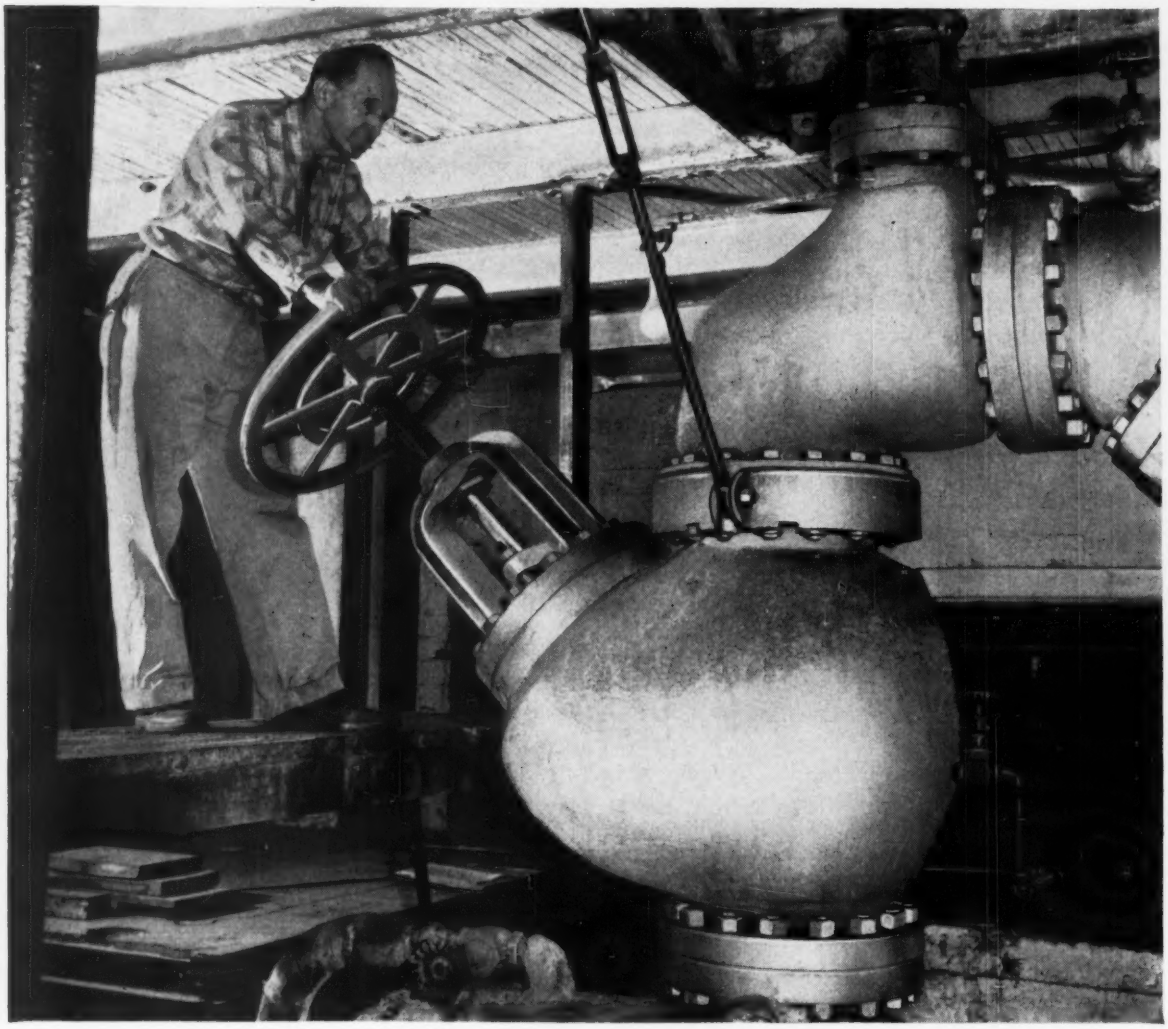
## Crane Valves Pay for Themselves in Trouble-Free Maintenance



# Beginning another 50 years of cost-free valve service

This remarkable case history proves how the right valve can save money in repairs and maintenance—again and again.

This Crane 10-inch stop-check valve has been in use since 1906 at Seattle Cedar Lumber Mfg. Co., Seattle, Wash. Operating at 360° F. and 150 psi., the valve is closed every third or fourth night when one of 3 boilers is shut down. The valve is also closed every 3 weeks when the boiler is down for inspection and cleaning. About a year ago, this Crane No. 28E Ferrosteel valve was opened for inspection, cleaned up, and put back into service. Repair parts needed? None.

In short, all 50 years have done to this Crane valve is emphasize how rugged and dependable it has proved, and how important it is to use quality valves on every service. For complete information on any valve problem, contact your Crane Representative.

**YOU'LL FIND GOOD** tips on valves in "Valve Performance Facts"—32 case histories throughout industry. Ask your Crane Man for a copy or write to address below.

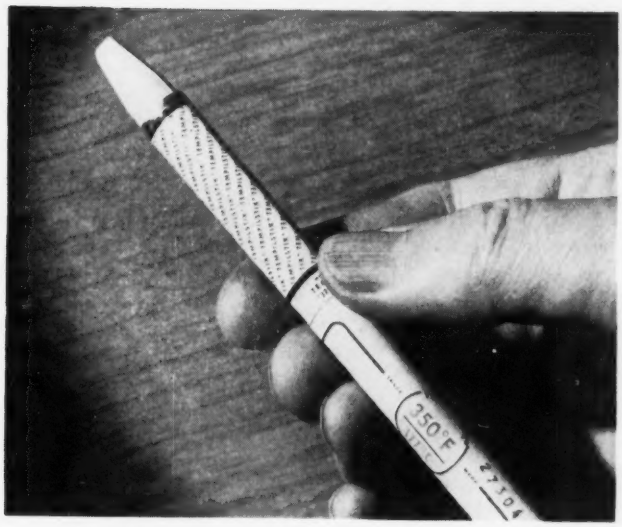
# CRANE VALVES & FITTINGS

**PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING**

*Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas*

# *speaking of* **Power**

## Crayons + creative editing = a problem solved




**Technical editors** act as communicators most of the time—they seek new ideas and know-how from men in the field and, through the pages of a magazine, pass the info along to men who can put it to work profitably. A *good* technical editor displays ingenuity and energy in canvassing idea sources, sound judgment in selecting material, and skill in presenting ideas for fast assimilation by the user, his reader.

**Topnotch editors,** we believe, add another dimension to this basic job—what we like to call *creative editing*. In addition to passing along the new ideas of others, they develop, on their own, solutions to problems bothering men in the field. A good example is the article by Assistant Editor Bob Bellas in May: "Something New in Trap Maintenance."

**Checking trap operation** by temperature difference isn't a new technique. Nor is the use of temperature-indicating crayons—they're well-known in welding shops, foundries, etc. But when Bellas put these two ideas together, he came up with what looked like a smart way to spot leaky traps. After getting the idea tested in a number of plants, Bob was convinced the method was sound and the POWER article was the result. Or the first result, anyway.

**The real payoff** was yet to come: Into our office came a flood of letters from engineers all across the U.S. and Canada, and from spots as far away as Australia and Egypt. All said Bob's trap-testing method sounded swell, all wanted to know where they could get temperature-indicating crayons like those described in the article. And that wasn't all—the same thing was happening at the plant of Gering Products, Inc, mentioned in the article as the place where the method was tested. Their switchboard was kept busy handling calls from POWER readers, and Neil Koop, plant engineer, was getting a flock of inquiring letters. All in all, it looks like Bob Bellas did a real job of creative editing—put his imagination to work and solved a common plant problem.

**The MicroRingelmann chart** introduced by POWER back in March 1954 was another example of creative editing. Knowing the difficulty of using the conventional Ringelmann chart for smoke measurement, we worked out a scaled-down version that could be held at arm's length, making one-man use easy. The steady flow of requests for copies of these handy charts exhausted our original generous supply and we've had to make another printing. You'll be glad to know that MicroRingelmanns are again available—at 35¢ each for single copies, 25¢ each for 10 or more, and 20¢ each for 100 or more.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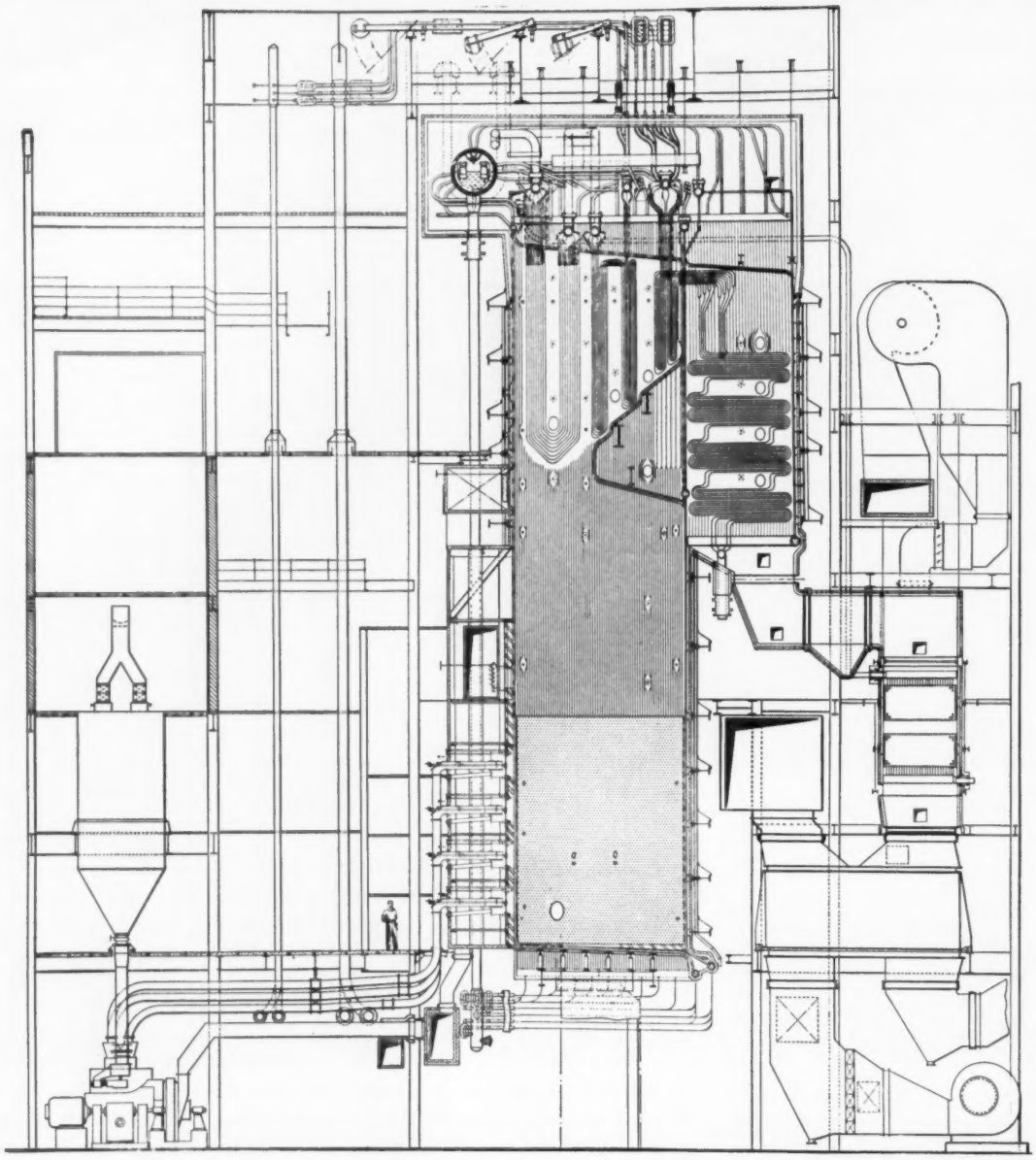


Latest unit for Burlington Station, Public Service Electric & Gas Company has a capacity of 1,350,000 lb of steam per hr. Comprehensive circulation tests on this unit, plus more than a year of sustained performance, proved that natural circulation boilers can operate easily with drum design pressures of 2800 psi, for throttle conditions over 2400 psi.

**B&W NATURAL CIRCULATION BOILERS ABOVE 2600 PSI DESIGN PRESSURE**

| NAME OF UTILITY | STATION | NO. UNITS | DES. PRESS. psi | THROTTLE PRESS. psi | TOTAL TEMP. F | REHEAT TEMP. F | TOTAL KW |
|---|---|---|---|---|---|---|---|
| Indiana & Michigan Electric Co. | Twin Branch | 1 | 2650 | 2335 | 940 | 900 | 76,500 |
| Public Service Electric & Gas Co. | Burlington | 1 | 2700 | 2350 | 1100 | 1050 | 200,000 |
| Public Service Electric & Gas Co. | Linden | 1 | 2700 | 2350 | 1100 | 1050 | 225,000 |
| Southern California Edison Co. | Huntington Beach | 2 | 2700 | 2400 | 1050 | 1000 | 400,000 |
| Virginia Electric & Power Co. | Bremo | 1 | 2700 | 2400 | 1000 | 1000 | 150,000 |
| International General Electric Company | Chiba | 1 | 2700 | 2400 | 1060 | 1010 | 175,000 |
| Memphis Light, Gas & Water Div. | Thos. H. Allen | 3 | 2825 | 2400 | 1053 | 1053 | 862,500 |
| Detroit Edison Co. | St. Clair | 1 | 2700 | 2400 | 1050 | 1000 | 325,000 |
| Virginia Electric & Power Co. | Portsmouth | 1 | 2700 | 2400 | 1000 | 1000 | 150,000 |
| Southern California Edison Co. | Mandalay | 2 | 2700 | 2400 | 1050 | 1000 | 400,000 |
| Pacific Gas & Electric Co. | Pittsburg | 2 | 2725 | 2400 | 1050 | 1000 | 660,000 |
| TOTAL CAPACITY SERVED | | | | | | | 3,624,000 |

# If You Are Considering...

# 2400 PSI THROTTLE CONDITIONS

# You'll Want to Investigate B&W's Unique Experience

There's a reason why so many progressive utility companies and their engineers, thinking of turbine throttle conditions of 2400 psi, have turned to B&W. It is the unique record of performance of B&W high pressure natural circulation boilers.

**Simplicity of installation and operation** has been brought to high pressure steam generation by B&W natural circulation boilers. They have lower operating costs because no machinery requiring power and maintenance is needed for circulation.

**Long range operating experience**—since 1939—has been gained with natural circulation high pressure boilers operating above 2000 psi. Operators' success with natural circulation boilers is due to the B&W Cyclone Steam Separator, and a design which makes liberal use of outside downcomer capacity and provides proper balance of makeup and riser tubes.

**Clean turbines are an extra plus value.** Cyclone Steam Separators not only maintain good circulation, but, used with Steam Washers, they maintain exceptionally clean turbines. At one plant, where a B&W Radiant Boiler has been on the line constantly for a year, the turbine manufacturer reports that the turbine is the cleanest high pressure unit his engineers have ever seen. And tubes in the high duty part of the furnace are as clean internally as the day they were installed.

**B&W first designed natural circulation** boilers for operation at drum pressures over 2000 psi nearly 20 years ago. Today 86 B&W natural circulation boilers with these high design pressures are in operation and 52 more are being built.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-845-C5

BABCOCK & WILCOX

BOILER DIVISION

# IMPROVED BLOWER NOZZLE and

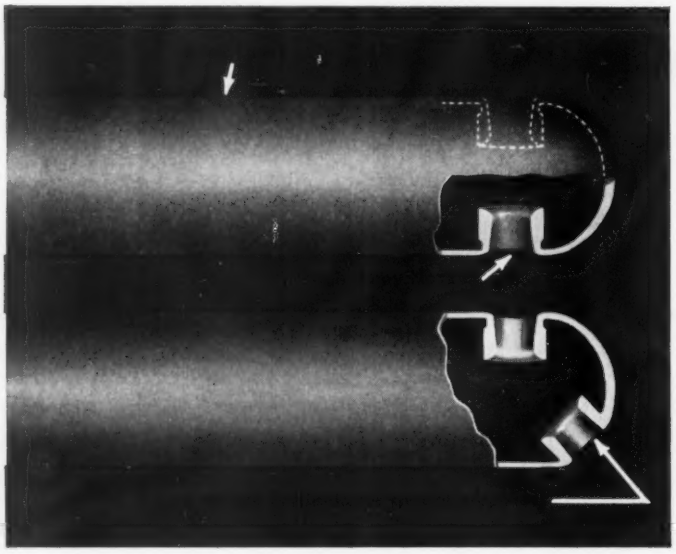
more important features of the

*New* Diamond Series 300 IK
LONG RETRACTING BLOWER

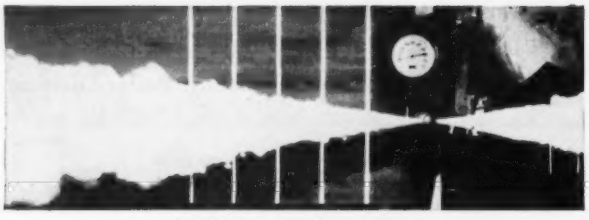
This improved nozzle provides more available cleaning energy per pound of steam or compressed air. A modified venturi, it is the result of extensive research during which more than 50 contours were tested.

The positively-controlled, close helical cleaning pattern assures optimum coverage of the heating surface. Return travel path is exactly intermediate to forward travel path . . . resulting in a positive nozzle sweep every inch.

These features are two of many reasons why the Diamond Series 300 IK Blower does a better and more economical job of cleaning surfaces which require a long retracting blower. Other advantages are listed at the bottom of the opposite page. Ask the nearest Diamond office for Bulletin 2111U which will tell you much more about the new Series 300 IK.

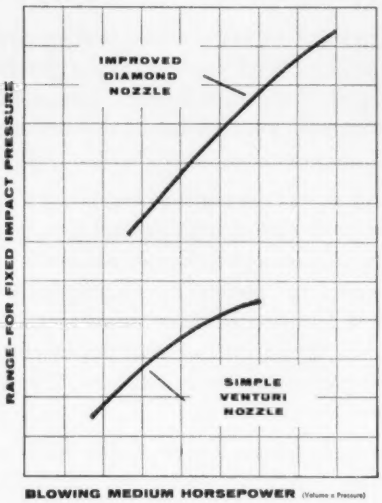


Improved Diamond Type "A" Nozzle has low approach velocity for optimum nozzle performance (see curves below). It provides greatest impact for any given blowing pressure . . . means greater effectiveness and economy.



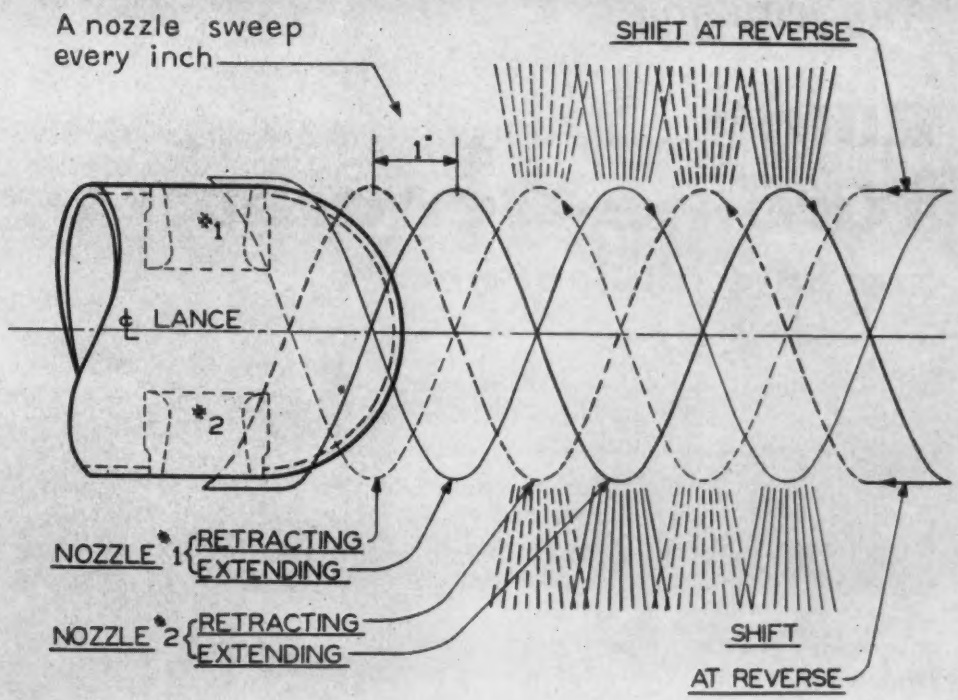
IMPROVED DIAMOND NOZZLE

7818 SIMPLE VENTURI NOZZLE


IMPROVED DIAMOND NOZZLE
SIMPLE VENTURI NOZZLE
RANGE—FOR FIXED IMPACT PRESSURE
BLOWING MEDIUM HORSEPOWER (Volume x Pressure)

Note the greater blowing range of the improved Diamond Nozzle when compared with a simple venturi nozzle under identical test conditions.

# IMPROVED CLEANING PATTERN




Nozzle-sweep-every-inch blowing pattern assures COMPLETE coverage of ALL surface EVERY time

**DIAMOND POWER SPECIALTY CORPORATION**

LANCASTER, OHIO

*Diamond Specialty Limited*

*Windsor, Ontario*

**OTHER ADVANTAGES OF SERIES 300 IK BLOWERS**

- Backbone and Protective Cover
- Front End Single-Motor Drive
- Compact, Accessible Electric Power and Control Terminal Facilities
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

***No other blower gives you all these advantages.***

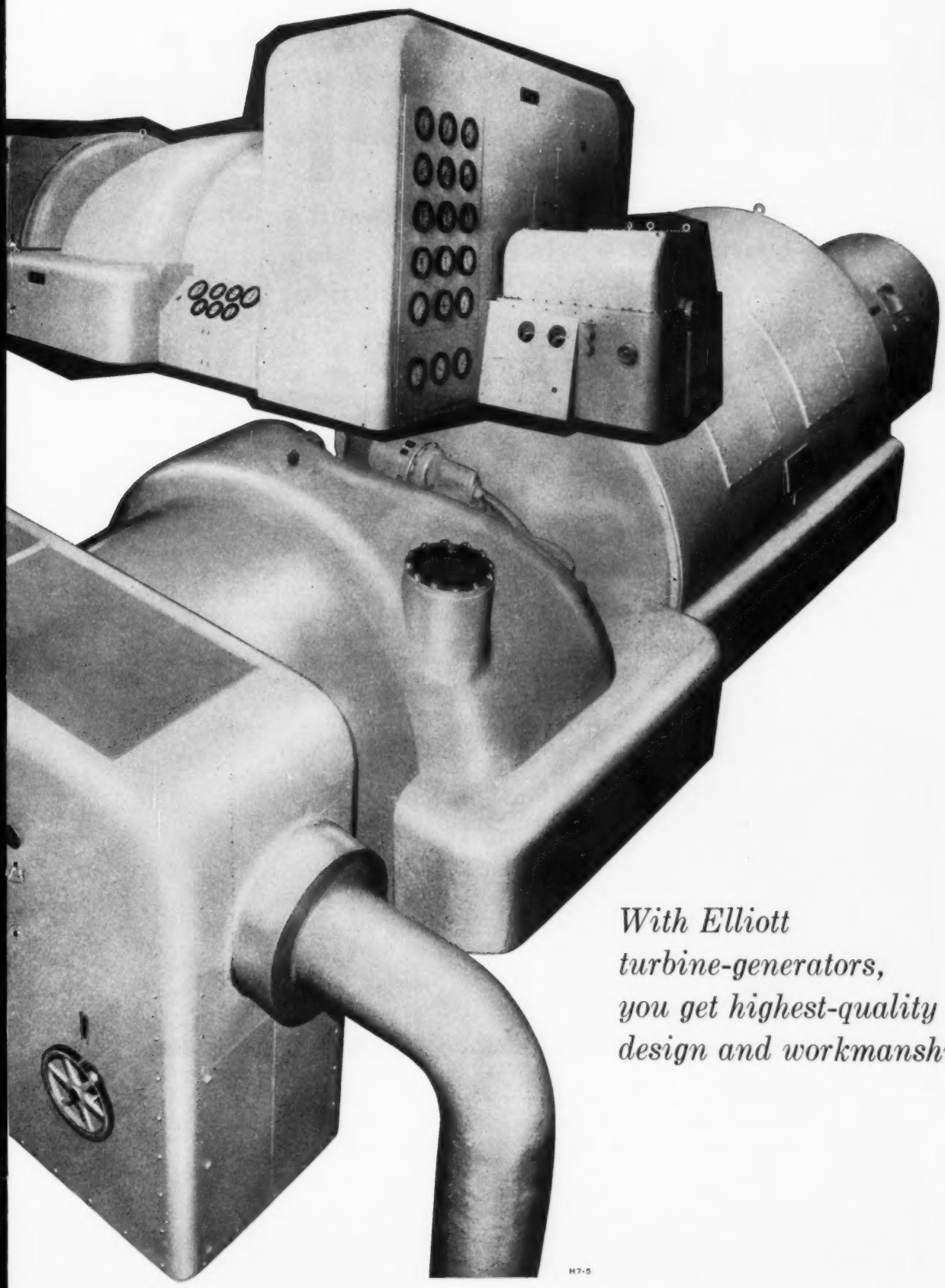
*Any way you look at it...*

# Elliott Turbine-Generators

## are an excellent choice

In the size rating through 44,000 kw, Elliott engineers and craftsmen have combined their skills toward a finer, more perfect turbine-generator unit—capable beyond nameplate rating . . . of extra rugged construction . . . with flexibility over a wide range of loads . . . and highest efficiency. The Elliott hydrogen-cooled unit pictured here is serving a utility plant with distinction. For turbine-generator data, call your nearby Elliott district office or write Elliott Company, Steam Turbine Department, Jeannette, Pa.

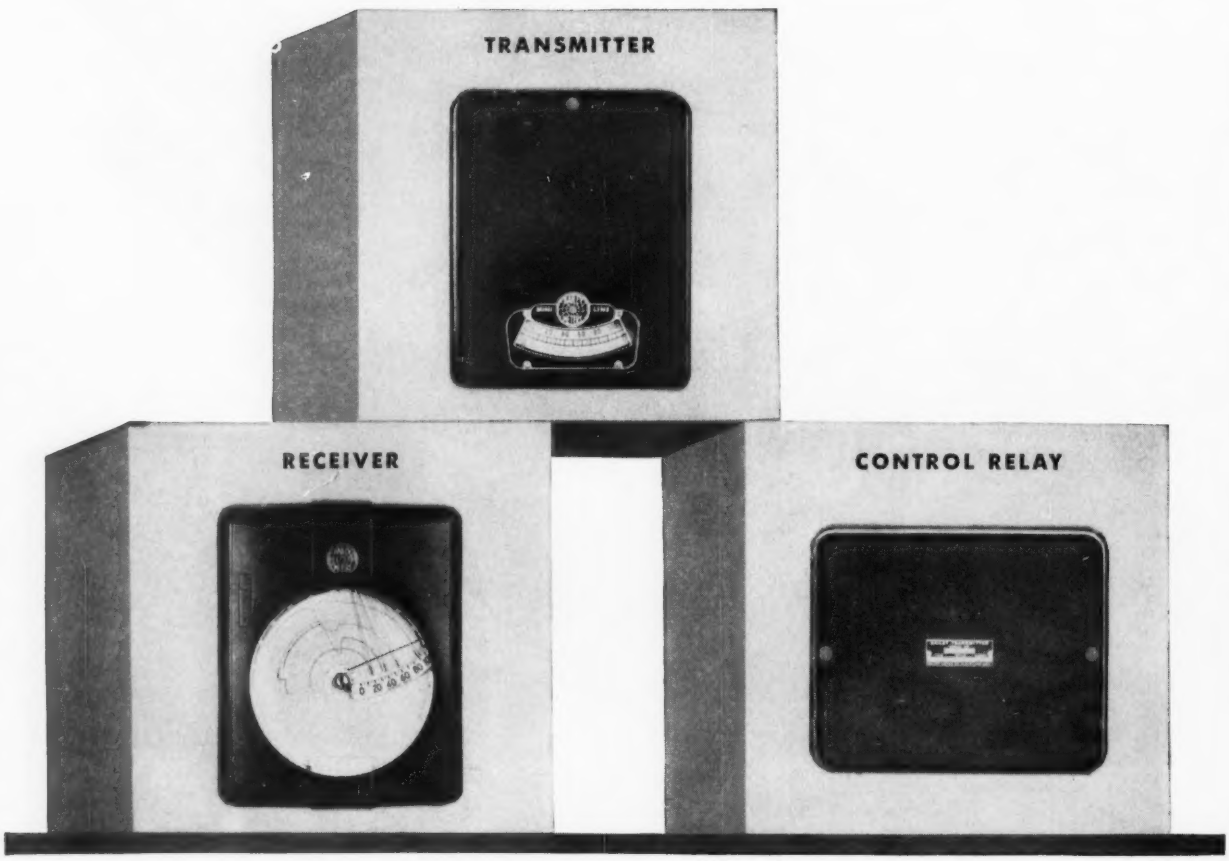
**ELLIOTT Company**



*With Elliott turbine-generators, you get highest-quality design and workmanship*

H7-5

# How to simplify




The Bailey Building Block Method enables you to simplify control problems by combining standardized measuring, transmitting, and controlling components as required.

# control problems

## Keep systems flexible, carry small inventory, cut maintenance cost with the **Bailey Building Block Method** of instrumentation and control.

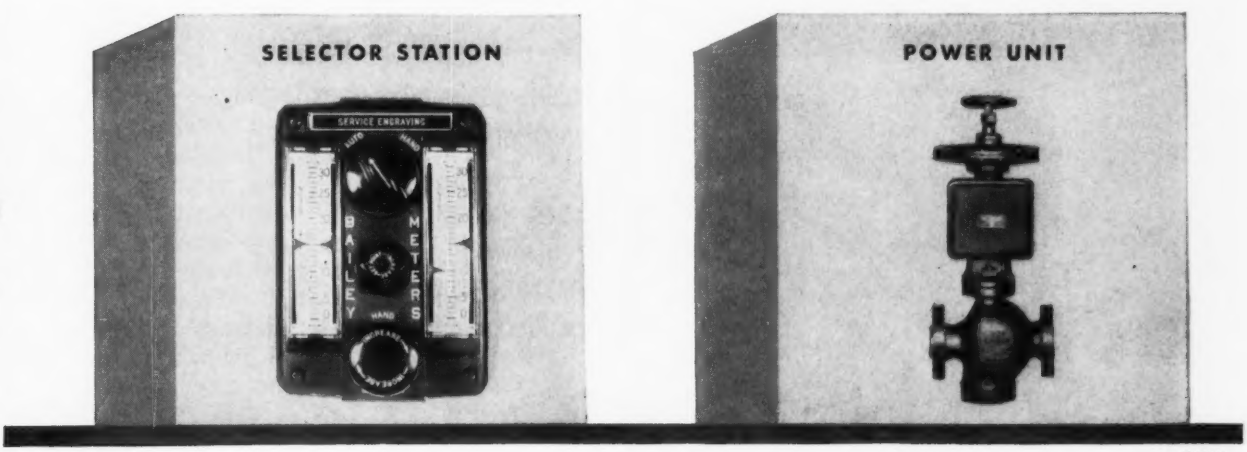
What is the Bailey Building Block Method? It's using standardized Bailey measuring, transmitting, and controlling components and combining them into any system you need. Components can be added as needed . . . removed and reused elsewhere . . . recombined into another system when the need changes. It's flexibility plus!

It's all based on the simple fact that a Bailey instrument or control component doesn't care if the measured variable is steam flow, tank level, or heater temperature, to pick just three examples. System components—transmitters, receivers, relays, selector stations, power units—are standardized for multi-purpose use.

A spare component can be used in any one of many systems. Gone are delays waiting for shipments of special parts. Gone are large inventories of spares and parts. Simplified is the training of men for maintenance.

There are many exclusive features and advantages of the individual components used in the Bailey Building Block Method. And there's much more to the Building Block story itself.

For further details, call our local district office or write us at Cleveland. Our engineers will be glad to prove how the Building Block approach will save you money and simplify your instrument and control problems.



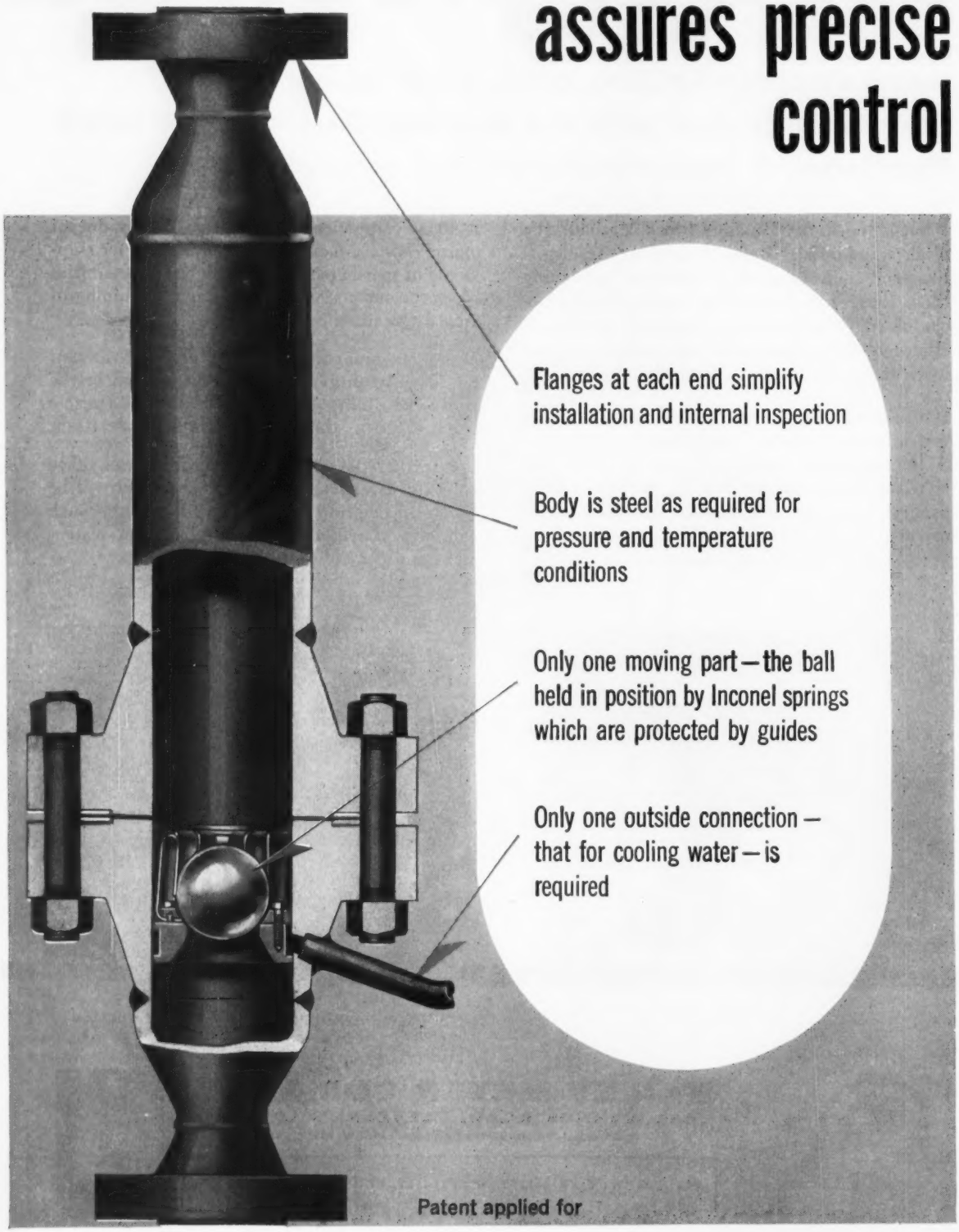

G36-2

BAILEY. BUILDING BLOCK METHOD

**BAILEY METER COMPANY**
**1036 IVANHOE ROAD, CLEVELAND 10, OHIO**
In Canada—Bailey Meter Company Limited, Montreal

RESULTS IN: FLEXIBILITY, SIMPLICITY, ECONOMY

# New—Copes-Vulcan Variable-Orifice assures precise control



Flanges at each end simplify installation and internal inspection

Body is steel as required for pressure and temperature conditions

Only one moving part—the ball held in position by Inconel springs which are protected by guides

Only one outside connection—that for cooling water—is required

Patent applied for

# Desuperheater temperature

Here is a unique desuperheating approach for close control of reduced steam temperatures, regardless of load variations. Using a weighted steel ball for controlling the orifice opening, this new Copes-Vulcan Variable-Orifice Desuperheater speeds the intimate mixing of cooling water and steam. Vaporization is so complete that reduced steam temperature can be held constant only 20 feet downstream from the desuperheater outlet — even over a 50-to-1 load range.

*Advance design means:*

- *No long run of piping needed to mix fluids*
- *No excess water to be removed from the steam*
- *No atomizing steam required*
- *No spray nozzle or glands*

Incoming steam lifts the ball an amount determined by the weight of the ball and the amount of steam flow. This assures a constant pressure drop of approximately 3 psig at all rates of flow, making possible precise control over extreme load ranges. Cooling water is controlled by a Copes-Vulcan valve responsive to the temperature controller.

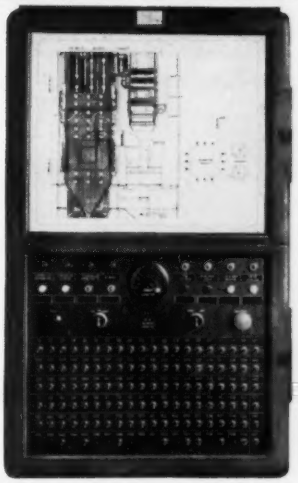
The Variable-Orifice Desuperheater is one of a complete line — each type engineered to meet particular operating conditions. Copes-Vulcan designs each station to meet your individual requirements.

COPES VULCAN

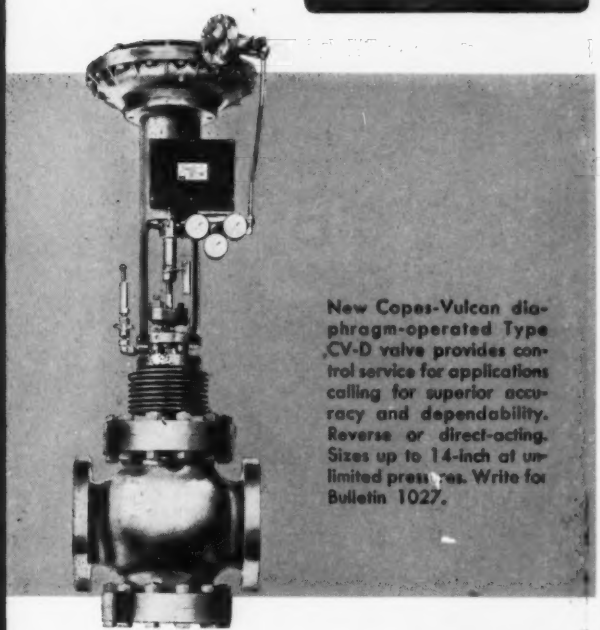
BLAW-KNOX

**COPES-VULCAN DIVISION**
**BLAW-KNOX COMPANY**
**ERIE 4, PENNSYLVANIA**

# C-V NEWS NOTES

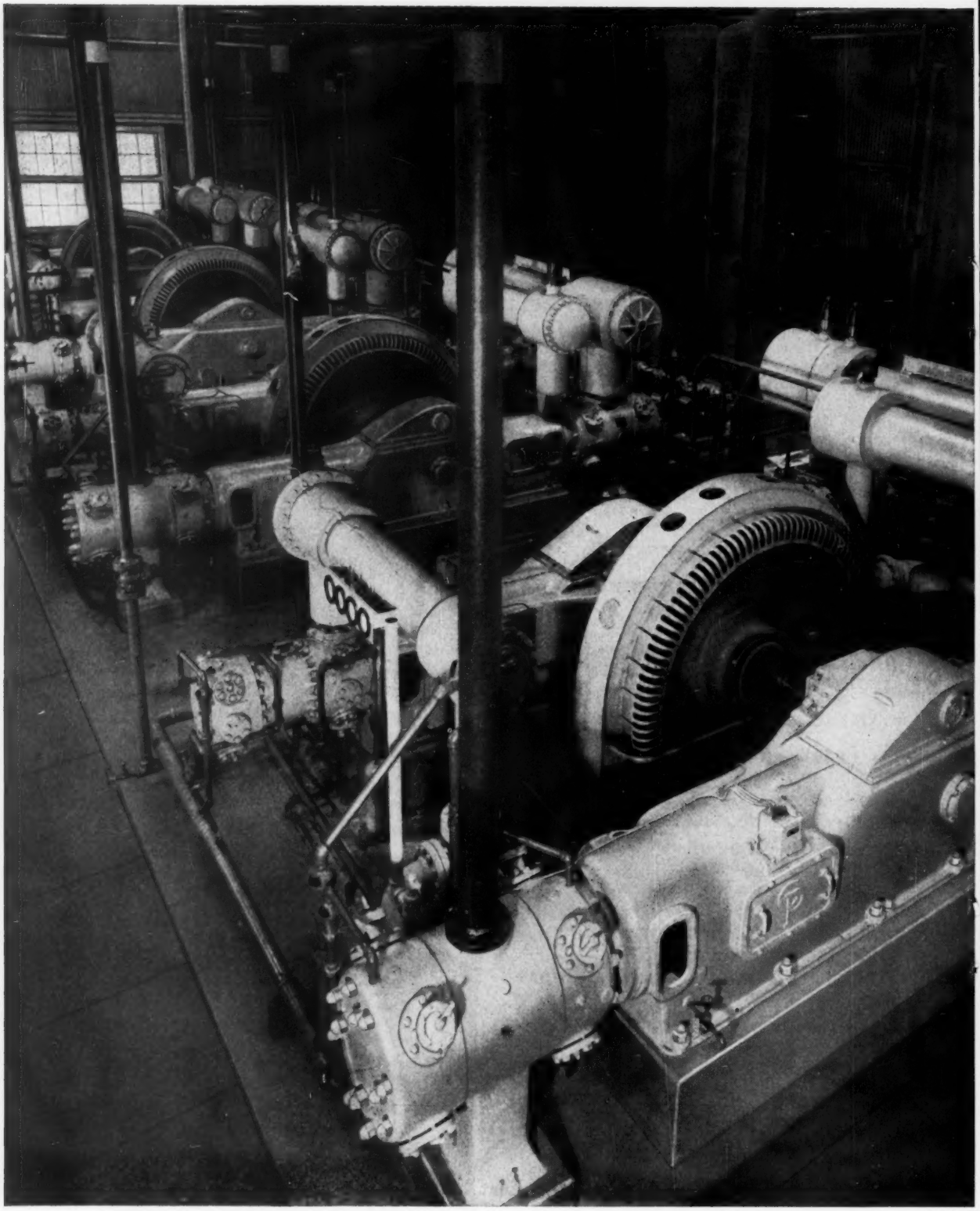


On order for a 5000-psig boiler in an Eastern utility station, this Vulcan Selective-Sequence Model SSC-120 control panel can preset four different or identical sequences of up to 120 soot blowers. 60-station Model SSC-60 control also available.

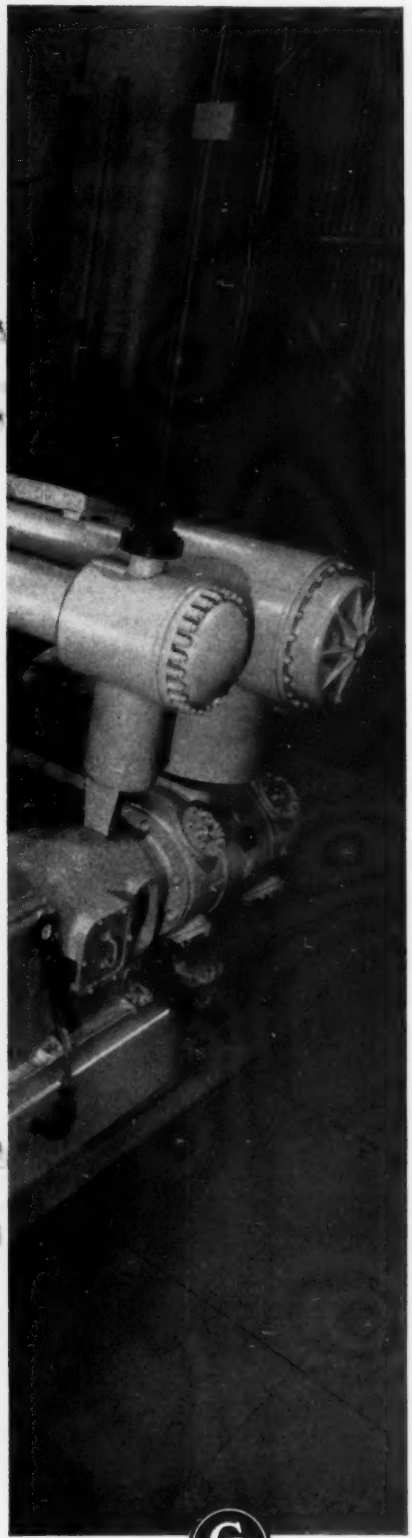


New Copes-Vulcan diaphragm-operated Type CV-D valve provides control service for applications calling for superior accuracy and dependability. Reverse or direct-acting. Sizes up to 14-inch at unlimited pressures. Write for Bulletin 1027.

New bulletin on Variable-Orifice Desuperheater gives complete description with specifications. Schematic drawings in color show typical installation and explain operating principle. For details, write for Bulletin 1037.



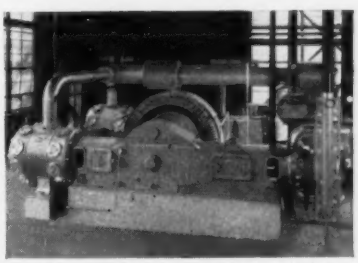
Four-stage Class H Compressors meet air liquefaction demands in a steel plant.



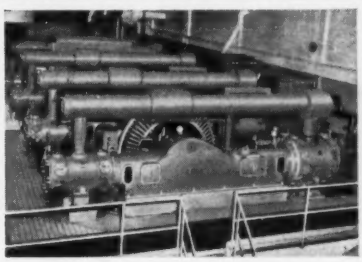
# Low Speed
# FOUR-CORNER COMPRESSORS

- *maximum availability*
- *minimum attention*
- *greatest accessibility*
- *readily adapted to multi-staging*

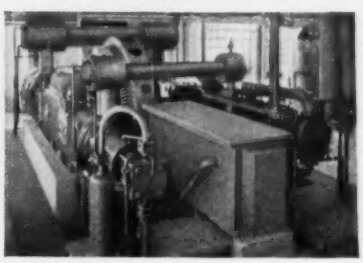
Chicago Pneumatic duplex, four-corner Class H Compressors afford optimum flexibility in arranging cylinders for one to six stages of compression, with correct distribution of load. These Class H Compressors, with motor or steam drive, are built in sizes to 2,000 horsepower for vacuum service or pressures to 15,000 psig. Other types available up to 5,000 horsepower.



Class H, three-stage compressor installed in a chemical plant.



A pair of Class H, two-stage compressors supplies air in a West Coast installation.



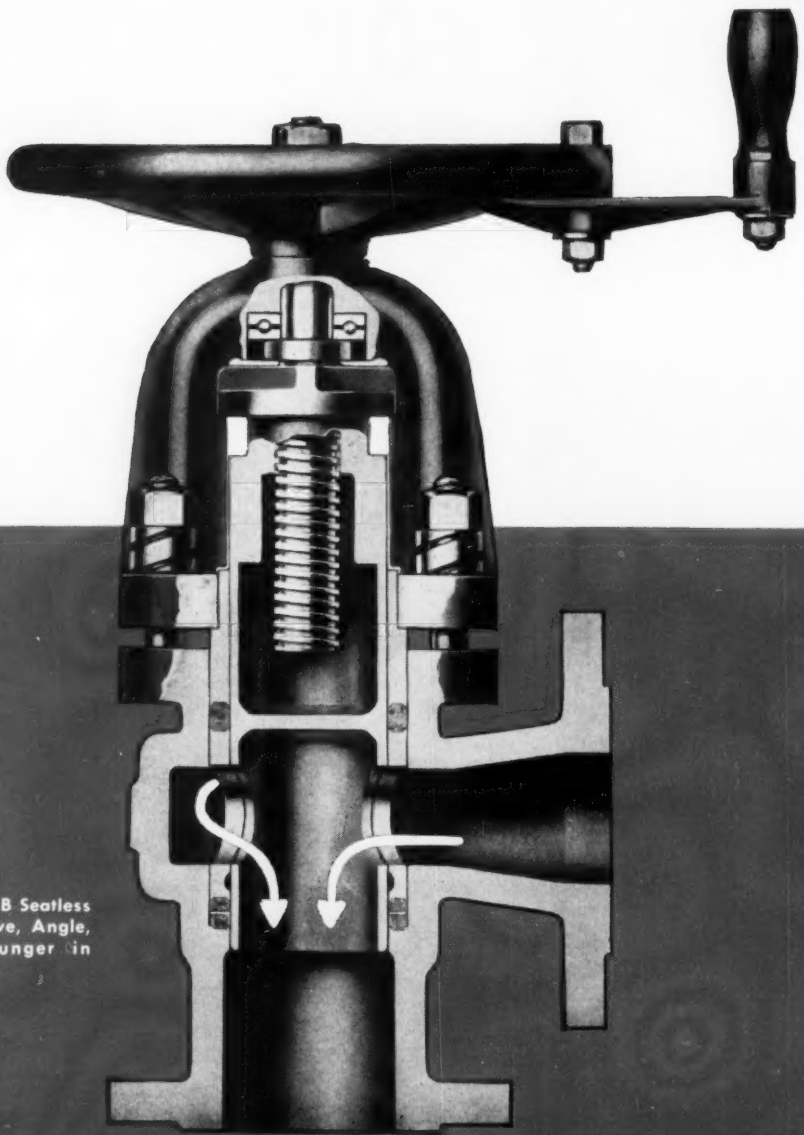
Five-stage, four-corner 3,000 psig compressor in Japan — the first of three.

**Chicago Pneumatic** 8 East 44th Street, New York 17, N. Y.

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

# seatless

## . . . for



Yarway Type B Seatless Blow-Off Valve, Angle, showing plunger in open position.

YARWAY

# trouble-free blow-down service

## YARWAY SEATLESS BLOW-OFF VALVES

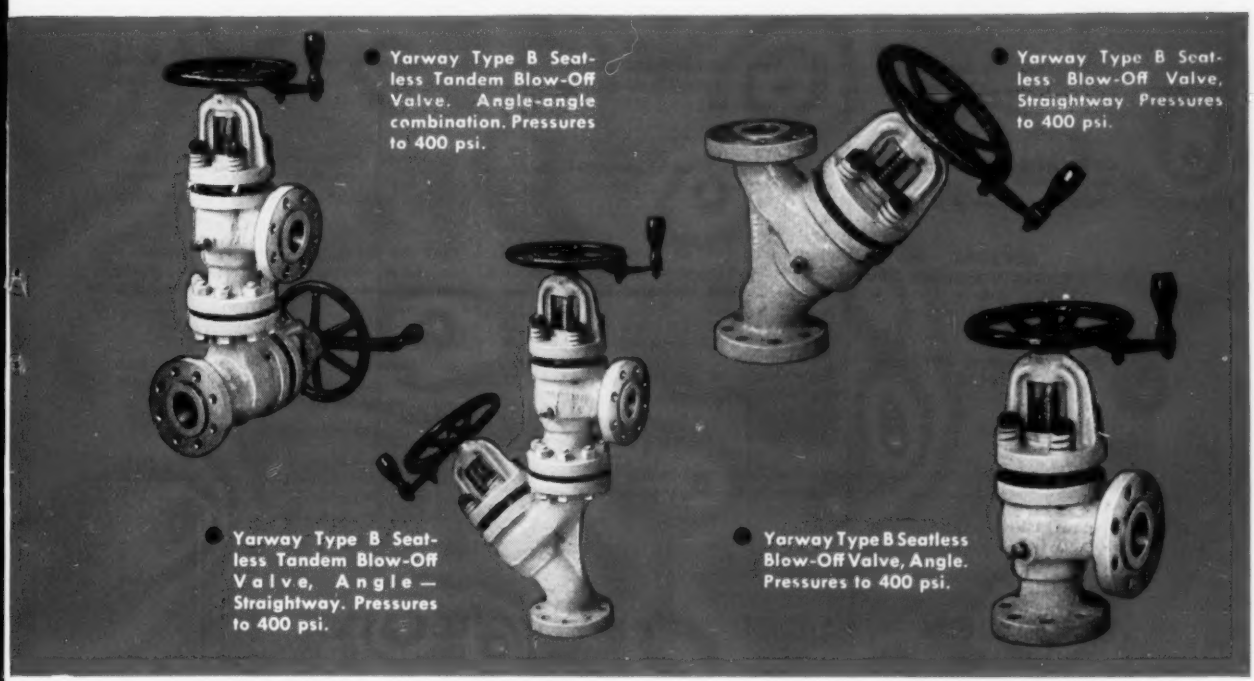
"Trouble preventers" is what YARWAY Seatless Blow-Off Valves are often called because they eliminate one of the commonest sources of trouble in low and medium pressure boiler blow-down service. *There is NO SEAT to score, wear, clog or leak.*

YARWAY Seatless Blow-Off Valves feature a balanced, sliding, hollow plunger design that permits free and easy operation—full, unobstructed flow.

*More than 16,000 boiler plants today use* YARWAY *Blow-Off Valves.*

YARWAY Bulletin B-426 shows all the latest types and features of YARWAY Seatless Blow-Off Valves. If you operate your boilers up to 400 psi, you'll find a copy helpful. For higher pressures, ask for Bulletin B-434. Write today.

**YARNALL-WARING COMPANY**
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES


Yarway Type B Seatless Tandem Blow-Off Valve. Angle-angle combination. Pressures to 400 psi.
Yarway Type B Seatless Blow-Off Valve, Straightway. Pressures to 400 psi.
Yarway Type B Seatless Tandem Blow-Off Valve, Angle—Straightway. Pressures to 400 psi.
Yarway Type B Seatless Blow-Off Valve, Angle. Pressures to 400 psi.

# — blow-off valves

*Because the mortar*

# Harbison-Walker more than 25 different

Refractory brick structures last longer when the bonding mortar matches the characteristics of the brick. The mortar should correspond with the brick in refractoriness, thermal expansion and other properties and should be compatible in chemical composition. To fulfill the requirements for the many different types and classes of refractory brick and operating conditions, Harbison-Walker produces more than twenty-five bonding mortars.

Included in this wide range are some mortars which set with a strong bond upon drying, which is retained at high temperatures, and others which acquire a good ceramic set only when heated. The

*Some of the Various Types and Classes*

| BRAND | DESCRIPTION | TYPICAL APPLICATIONS |
|---|---|---|
| **HARWACO BOND** wet or dry | Cold-Setting with strong bond and negligible shrinkage—alumina-silica composition—more refractory than any mortar of fireclay base. | Used for laying all classes of fireclay and high alumina brick in boiler settings—kilns—oil refining units—metallurgical furnaces. |
| **HARWACO MASTIC** wet or dry | Corresponds to HARWACO BOND in composition—especially adapted for use in thick plastic consistency. | For pointing or sealing cracks in brickwork—as a protective coating—monolithic packing back of water-wall tubes—air duct linings. |
| **CORALITE BONDING MORTAR** wet | High alumina cold-setting cement of unusually high refractoriness. | For laying all classes of alumina-silica brick used at unusually high temperatures in contact with molten metals and various corrosive slags. |
| **KORUNDAL BONDING MORTAR** dry | Cold-setting bonding mortar containing approximately 85% alumina. Mineral composition mullite and corundum. Extremely high in refractoriness. | Used for laying all classes of high-alumina brick. Very resistant to corrosion by volatile alkalies and slags of certain metallurgical furnaces. |
| **H-W CORUNDUM BONDING MORTAR** dry | Substantially an all corundum cold-setting mortar of 99% alumina content. | The ultimate in refractoriness among high alumina mortars—used with greatest benefit at highest temperatures. |
| **THERMOLITH** dry | Chrome base cold-setting mortar. Highly resistant to many very corrosive fluxes. | Most extensively used for laying magnesite, chrome and forsterite brick. Also favored for use with fireclay and high alumina brick in many special applications. |

**HARBISON-WALKER REFRACTORIES COMPANY**
AND SUBSIDIARIES

*World's Most Complete Refractories Service*

**General Offices: PITTSBURGH 22, PA.**

*is as important as the brick . . .*

# Walker provides BONDING MORTARS

mortars with hot-setting properties contribute to flexibility in expansion and contraction of structures which are subjected to soaking heats throughout. Chemical compositions vary from highly basic, through various degrees of neutral to strongly acid, and in each specific case provide for maximum resistance of the joints to the widely different corrosive slags and fumes. Among these compositions are those consisting largely of magnesia, forsterite (magnesium silicate) chrome, corundum (stabilized crystalline alumina), silica and alumina-silica in various ratios.

Adequate refractoriness to secure the most durable and impervious joints and smooth-working plasticity with proper water retention are other properties of major importance for these mortars.

In addition to the different kinds described in the following table, Harbison-Walker produces others, including hot-setting mortars such as H-W FURNACE MAGNESITE, H-W SPECIAL FURNACE CHROME, H-W BONDING MORTAR and various brands of finely ground high duty and super-duty fireclays as well as several modifications of silica cements and mortars primarily for laying insulating fire brick.

From these bonding mortars can be selected those best suited for each specific application to secure longest furnace life and greatest economy.

*of Harbison-Walker Bonding Mortars*

| BRAND | DESCRIPTION | TYPICAL APPLICATIONS |
|---|---|---|
| **H-W FORSTERITE BONDING MORTAR** dry | Strong cold-setting, magnesium silicate mortar of basic character. | For use at high temperatures with H-W FORSTERITE brick in glass-melting and various metallurgical furnaces. |
| **H-W PERIKLASE BONDING MORTAR** dry | Basic, highly refractory, cold-setting mortar used for laying H-W PERIKLASE and other basic brick. | Used in electric and open hearth steel melting furnaces, glass furnaces, rotary kilns. |
| **FIREBOND** dry | Siliceous cold-setting bonding mortar having the property of high resistance to siliceous slags. | Used for laying silica brick where strong bonded joints are desirable and with fireclay brick for dense impervious joints at moderate temperatures. |
| **VEGA BOND** dry | Hot-setting silica cement of super-duty quality. Non-shrinking and smooth working. | For laying and grouting conventional and super-duty silica brick in all their applications. |
| **ANKORITE** dry | High alumina hot-setting mortar possessing excellent working qualities. Provides flexibility to brickwork in soaking heats over an intermediate temperature range and a strong set at the furnace operating temperatures. | Used for laying super-duty and high duty fireclay brick and the various classes of high alumina brick where a highly refractory heat setting mortar serves to best advantage. |
| **H-W WEATHERED BOND B CLAY** dry | Hot-setting bonding mortar. Excellent plasticity and bonding qualities developed by a long weathering process. | Used with splendid results for laying fireclay brick in boiler settings, iron blast furnaces and stoves. |

***Use this coupon to get prices and additional information about Harbison-Walker Bonding Mortars***

Harbison-Walker Refractories Co.
Pittsburgh 22, Pa.

Please send me prices and information about the following bonding mortar(s)

_____

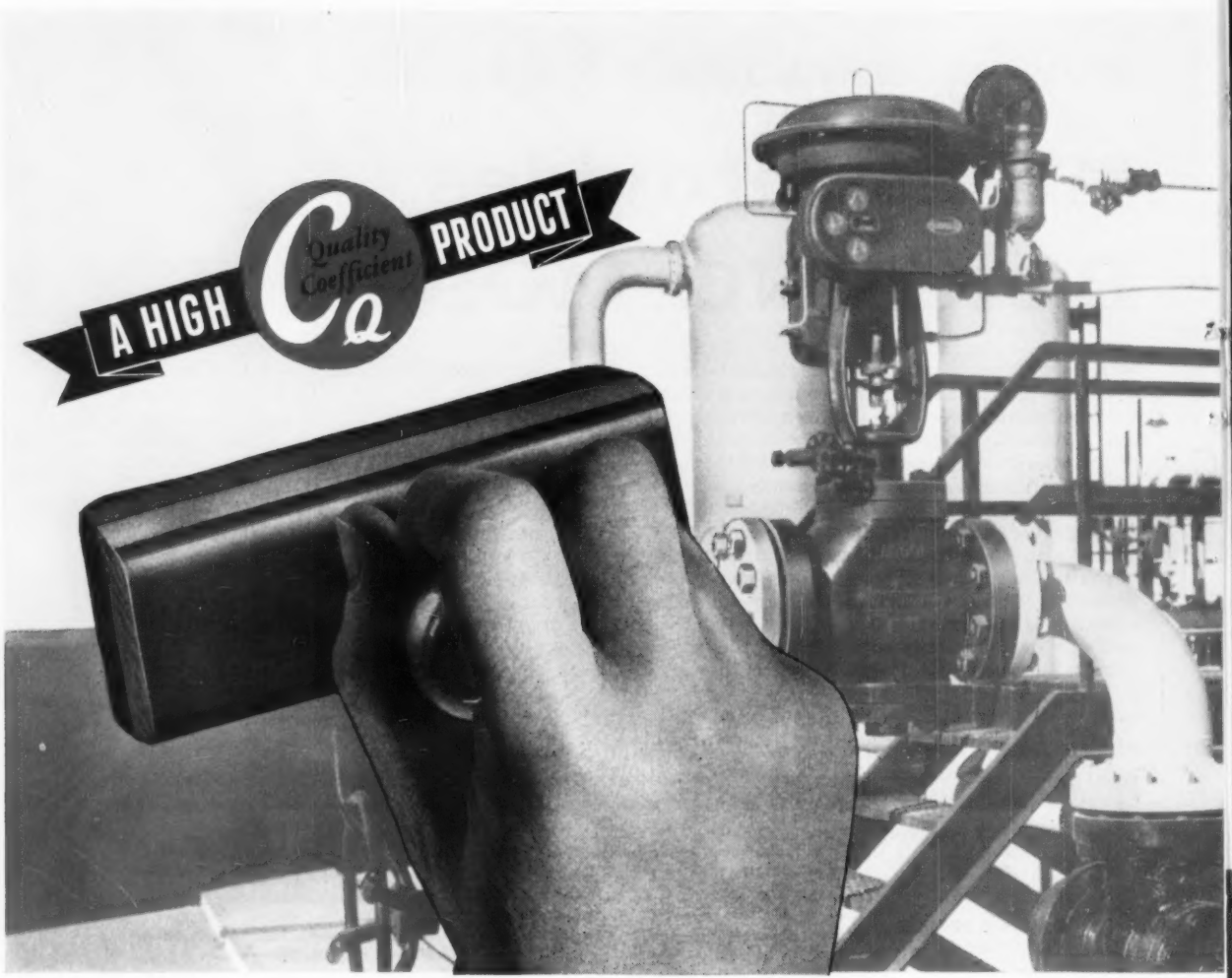
_____

NAME_____ POSITION_____

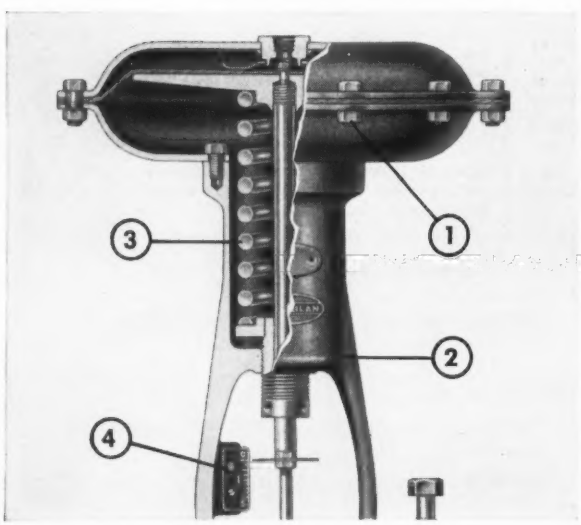
COMPANY_____

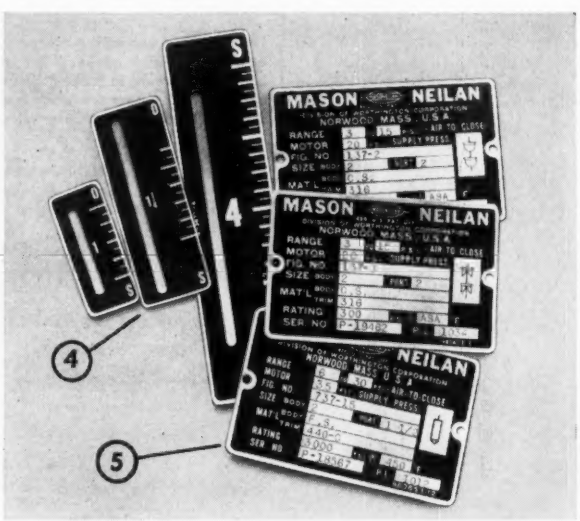
ADDRESS_____

_____




(1) Bolted diaphragm case assures tightness, offers no pockets to accumulate moisture, permits use of flat stock diaphragms in emergency. (2) Cast iron yoke provides inherent rust resistance and rigidity — cannot get out of alignment. (3) Standard 6-30 psi range springs available (at no extra cost) for easy interchangeability with 3-15 psi range. (4) Stroke scale shows actual increments of plug travel. (5) Full specification data on serial plate gives complete information at a glance.



# Masoneilan Control Valves Pioneer in

# Design To Cut Downtime!

## Practical Engineering Builds In Features to Speed Servicing, Reduce Time Losses

Practical engineering aims at reducing maintenance to a minimum and speeding unavoidable servicing. That's one reason Masoneilan Valves find such widespread acceptance — they combine the economies of long life, low service costs and minimum downtime.

Mason-Neilan pioneers many high $C_q$ design features with the *maintenance man* in mind — making his job simpler and more speedily accomplished. Consider, for example, these ten ways in which proper design helps save important money. And for the full story on the complete line ask the office nearest you — or write

**MASON-NEILAN**

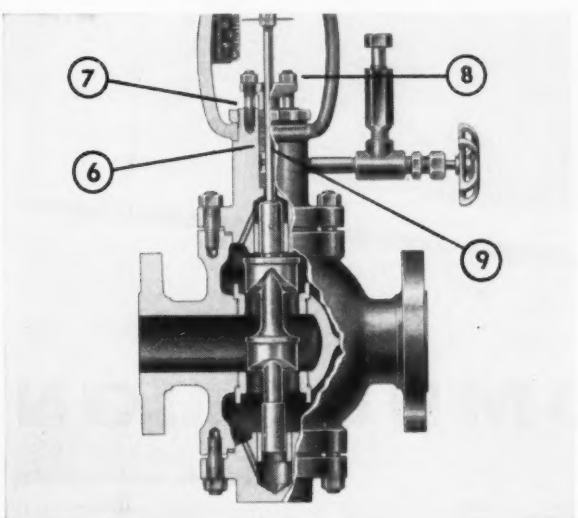
*Division of Worthington Corporation*

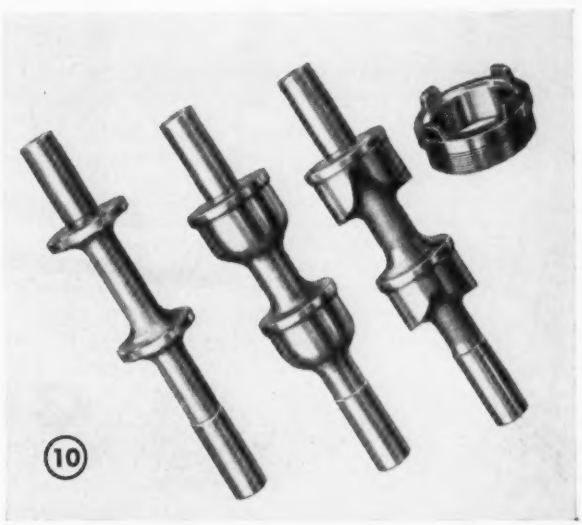
**33 NAHATAN STREET, NORWOOD, MASSACHUSETTS**

MASONEILAN

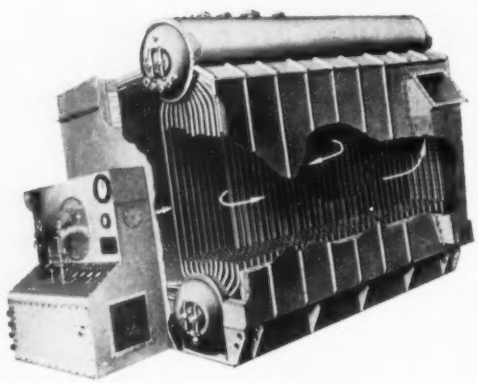
*Sales Offices or Distributors in the Following Cities:* New York • Syracuse Chicago • St. Louis • Tulsa • Philadelphia • Houston • Pittsburgh Atlanta • Cleveland • Cincinnati • Kansas City • Phoenix • Detroit San Francisco • Louisville • Salt Lake City • El Paso • Albuquerque Charlotte • Los Angeles • Corpus Christi • Denver • Appleton Birmingham • New Orleans • Seattle
Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

(6) Split-ring, preformed packing assures long service, ease of replacement. (7) Motor is easily removed from bonnet without disturbing packing box. (8) Bolted packing box assures maximum seal with minimum friction; provides visual check on packing life. (9) Superfinished stems move freely, reduce packing box friction, increase packing life. (10) Interchangeability of trim parts assures accurate fit of replacements, speeds conversion for change of process.



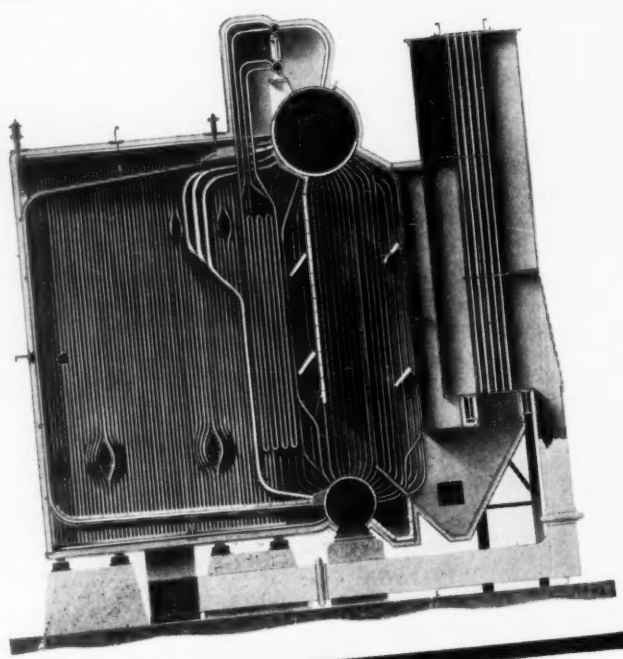



# MODERN OIL AND



**C-E Package Boiler—Type VP**

Completely shop assembled . . . available in fourteen sizes from 4,000 to 40,000 lb capacity . . . pressures to 500 psi. Available with integral console control panel, this unit contains more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. It can be equipped with any of several approved burners.



**C-E Vertical Unit Boiler —Type VU-55**

Available in six sizes . . . capacities from 50,000 to 120,000 lb steam per hour . . . designed for two pressure ranges, 250 psi and 500 psi, and total steam temperatures up to 750 F. This double cased, gas-tight unit is equipped with tangential burners. A large (60-inch) steam drum assures generous water capacity and steam reservoir space. Tangent tube waterwalls offer complete furnace protection, minimizing maintenance.

# COMBUSTION

**Combustion Engineering Building**

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER

# GAS FIRED BOILERS

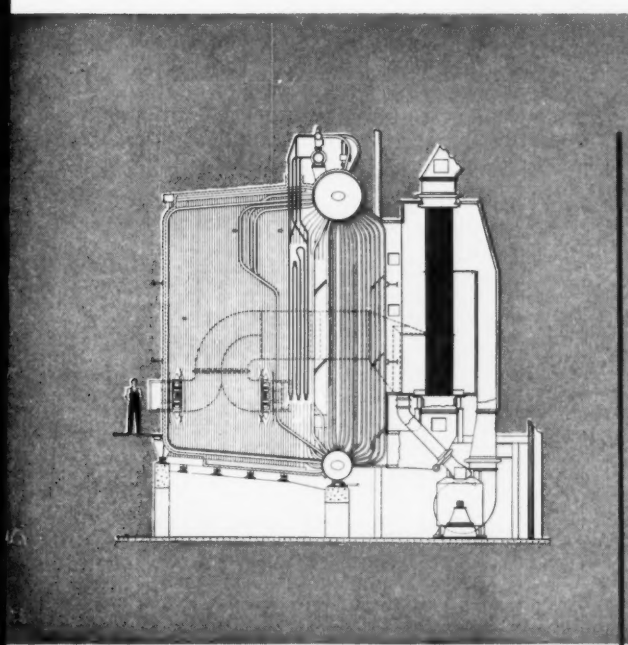
The boilers illustrated here cover the broad capacity range from 4,000 to 600,000 lb of steam per hr. They are all especially designed for gas and/or oil firing. The two units shown on the left page (Types VP and VU-55) are standardized and each is available in several sizes. The capacity range covered by these two units is from 4,000 to 120,000 lb per hr. The two units below are custom designed for various capacity, pressure and temperature requirements up to 600,000 lb per hr, 1400 psi and 950 F. All these units are pressure fired and do not require induced draft fans.

Collectively, they offer an exceptional diversity of choice. A brief consideration of the features of each type will help you "pinpoint" the design characteristics best suited to your particular needs.

Of course there are other C-E two drum Vertical-Unit Boilers available for pressures up to 1400 psi and temperatures up to 960 F. Shown here are but four popular members of the C-E family of Vertical-Unit Boilers—a family which has achieved a wide measure of acceptance using all types of fuel.

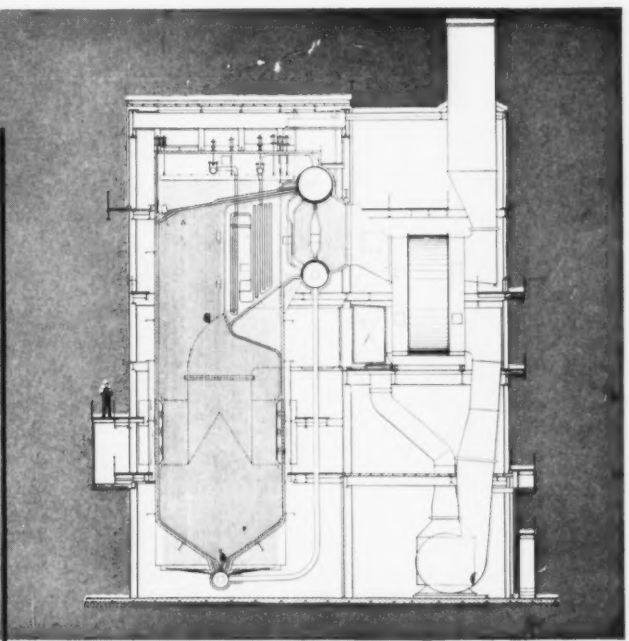
*Please feel free to call on us for further detailed information. Catalogs are available upon request.*

B-922



**C-E Vertical Unit Boiler—Type VU-50B**

This unit is available for capacities from 50,000 to 400,000 lb per hr—pressures to 1400 psi and temperatures to 950 F. This bottom-supported design uses tilting tangential burners providing effective superheat control. Horizontal burners can be furnished if desired. Heat recovery equipment as required. This unit makes available to industrial installations a standard of performance comparable to utility practice.



**C-E Vertical Unit Boiler—Type V2**

This unit is available for capacities from 200,000 to 600,000 lb per hr. It can be designed for pressures up to 1400 psi and for temperatures to 950 F. Tilting tangential burners, providing superheat control, are standard equipment although horizontal burners are available, if desired. A double, gas-tight casing assures lifetime tightness and minimum heat loss. Heat recovery equipment can be furnished as desired.


**ENGINEERING**

CE

**200 Madison Avenue, New York 16, N. Y.**

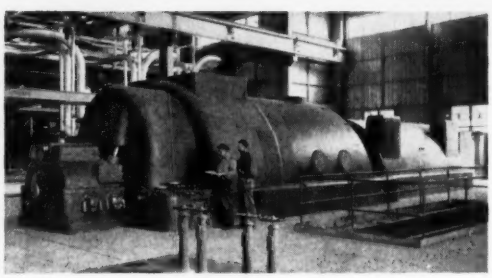
MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

*Bridgeport tubes fight "Coastline Corrosion" in Indiana*

**LARGEST ALUMINUM BRONZE CONDENSER TUBE**

Above Bridgeport Duronze condenser tubes are being rolled into Unit 6's condenser The completed installation required 6,420 pieces (104,834 lbs.) of Duronze IV. (Aluminum Bronze) 1" OD x .049" x 30'.

Of the six turbogenerators, the latest is approximately 61 ft. long and 17 ft. wide, uses 1,000°F. steam under 1,535 lbs. pressure. The tips of its longest blades move at a speed of 852 miles per hour—faster than the speed of sound.



*Bridgeport Brass Company, Bridgeport 2, Conn. • Offices in Principal Cities • In Canada: Noranda Copper and Brass Limited, Montreal*

H. T. Pritchard Power Station, located 18 miles southwest of Indianapolis, is the newest and largest of the five power plants of Indianapolis Power & Light Company. At full capacity, it generates 376,000 kws, burning about 3,000 tons of coal and using more than 325 million gallons of condensing water per day. Designed in 1946 for four generating units, it has been expanded to six units at a total cost of $51 million. All six are equipped with Bridgeport condenser tubes.

# INSTALLATION IN ANY INLAND POWER STATION

Unit 6, latest and largest generating facility at Indianapolis Power & Light Company's H.T. Pritchard Station, has a capacity of 105,000 kw. Its giant 50,000 sq. ft. Lummus condenser contains 192,600 feet of Bridgeport Duronze IV (Aluminum Bronze) condenser tube.

The selection of Duronze for Unit 6 is a story of special interest to power engineers. It is the result of more than ten years of continuous cooperative research and record keeping by Indianapolis Power & Light's engineering staff, their consultants, Gibbs & Hill, and Bridgeport's Corrosion Laboratory. Another close-by station on the same river served as the experimental "testing ground" on which to observe the performance of various condenser tube alloys, including Admiralty and Aluminum Brass. It was this careful preliminary work that led to the choice of Duronze despite its $13,000 higher initial cost.

Although Aluminum Bronze (Duronze IV) is usually associated with seaboard station installations, White River's use of this alloy in such quantity shows how complete and constant cooperation—in all phases of research and testing—combined to permit dependable planning. It serves, too, to prove that working closely with Bridgeport produces *success-in-service* operation.

You can benefit from Bridgeport's experience and cooperation on condenser tube applications. For prompt service, call or write the Bridgeport Sales Office nearest you.

## BRIDGEPORT CONDENSER TUBES

BRASS Bridgeport CO.

# How To Make Your FIRST Buy

## Rockwell-Edward forged steel inclined

### WELDED BONNET CAN'T LEAK

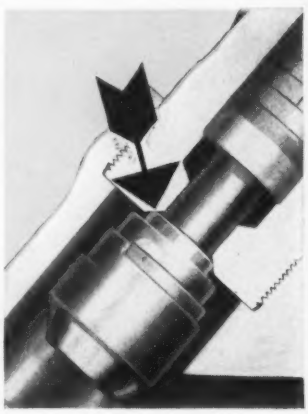
Seal-welded body-bonnet joint maintains pressure tightness in any service. Weld easily removed for disassembly. Threaded section and body shoulder carry pressure load and give accurate alignment. Exclusive Impactor handwheel, shown here, available only on 2½ in. size.

### HARD-FACED INTEGRAL SEAT

Continuous Stellite ring (arrows) applied to body and disk retains hardness at high temperature; resists corrosion and erosion. Stellited seat is precision-machined in same set-up as body bore, then carefully lapped to form drop-tight mated seating surfaces.

### TIGHT BACKSEAT SAVES PACKING

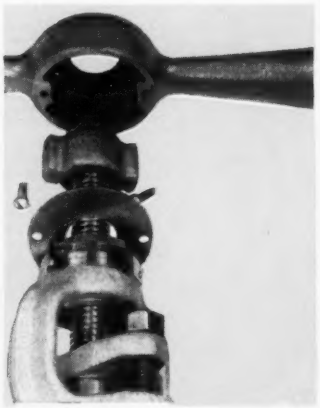
Radiused disk nut contacts plane beveled surface at the bottom of the bonnet, gives high load line contact capable of penetrating oxidation to create complete isolation of packing chamber from line pressure. This minimizes maintenance, increases packing life.



### CROSS ARM IMPACTOR* HANDLE

Now the famous Edward Impactor principle is applied to the larger forged steel Univalves. Delivers 2.8 times the closing load of ordinary handwheels. Assures tight seating with minimum effort in minimum space. Knobbed easy-grip handwheel on smaller size Univalves.

*T M. Reg. U.S. Pat. Off.



### WIDE RANGE OF USES

For steam, water, oil or gas: wherever pressure and/or temperature demand a dependable high-pressure valve the Univalve will do the job best. One line of standard valves will perform all drain, vent, bypass, blow-down, instrument take-off and all but the most difficult throttling functions. Shown here is a pair of Univalves used for boiler blow-off service.

### STREAMLINING CUTS FLOW RESISTANCE

Inclined stem and internal streamlining cut turbulence, reduce pressure drop, minimize wear. Edward scientists incorporate precise streamlining in every Edward valve. Wood dowel through bore of this Univalve demonstrates straight-through design.

## Rockwell-Built Edward Valves

# The RIGHT Buy In Steel Valves

## stem Univalve* is a good example . . .

The original cost of steel valves is often only the *beginning*. Frequently, on the heels of installation, comes a series of repairs (involving cost and service interruption) ending in premature replacement. How much *less* costly it is, in terms of cash and down-time, to buy steel valves which are "right"—right from the start.

This isn't always easy. Some valves scream "price", others assert "quality" without defining what they mean. It remains for Edward, long-time leader in the field, to step forward with a word of quiet assurance.

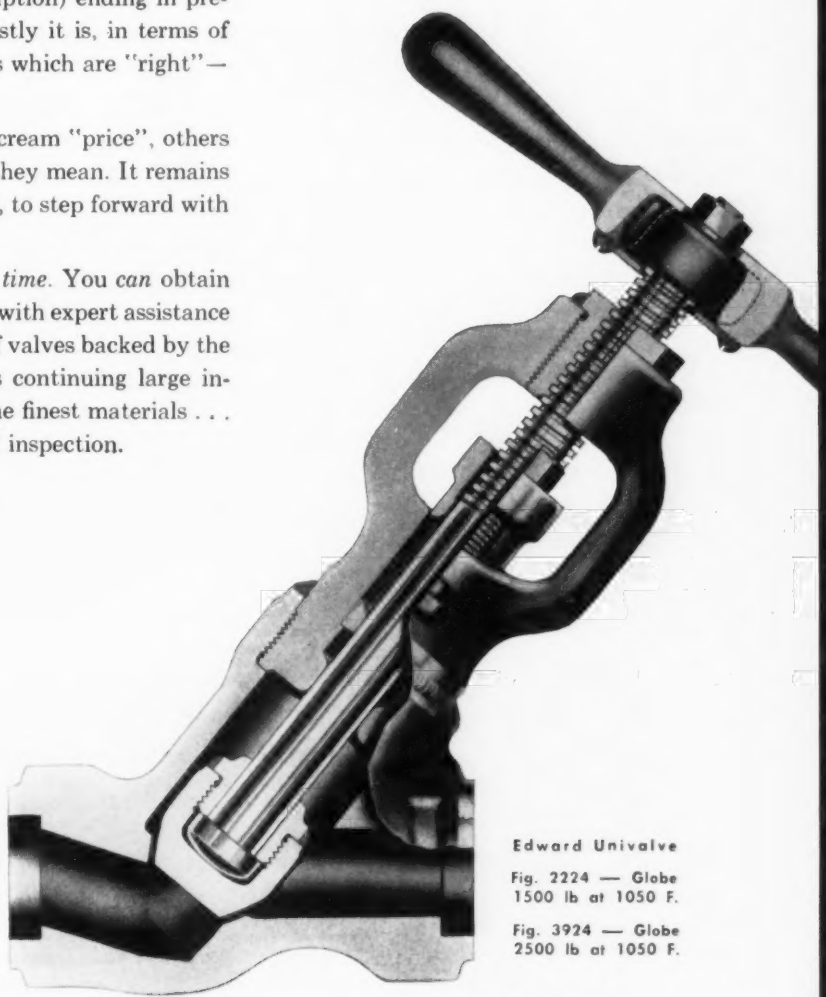
It *is* possible to "buy right" the *first time*. You *can* obtain steel valves exactly right for your needs, with expert assistance every step of the way. You can be *sure* of valves backed by the Edward reputation . . . the company's continuing large investment in valve research . . . use of the finest materials . . . and the most careful craftsmanship and inspection.

### UNIVALVE A GOOD EXAMPLE

Edward valves do not cost substantially more than competitive valves. But they give you a *great deal* more for your valve dollar. A case in point is that of the Edward inclined stem Univalve* pictured on these pages. At right, it appears in entirety; at left, upon the facing page, are a half-dozen of the premium features you will find in this valve. They invite your attention.

We respectfully suggest a visit from your Edward Representative. Technically trained, thoroughly experienced, his professional advice can save you headaches and money. There is no obligation, of course. Whether you are interested in steel valves for original installation or for replacement, it will pay you well to get in touch with us *today*.

*T.M. Reg. U.S. Pat. Off. — — Integral seat valves, with body and bonnet a single unit



Edward Univalve

Fig. 2224 — Globe
1500 lb at 1050 F.

Fig. 3924 — Globe
2500 lb at 1050 F.

Sizes from
¼ in. to 2½ in.

**Edward Valves, Inc.**

*Subsidiary of* ROCKWELL MANUFACTURING COMPANY

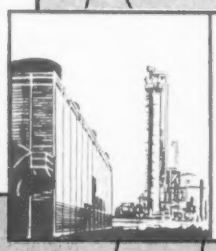
1230 West 145th Street, EAST CHICAGO, INDIANA

# Why 62 NEW FW COOLING

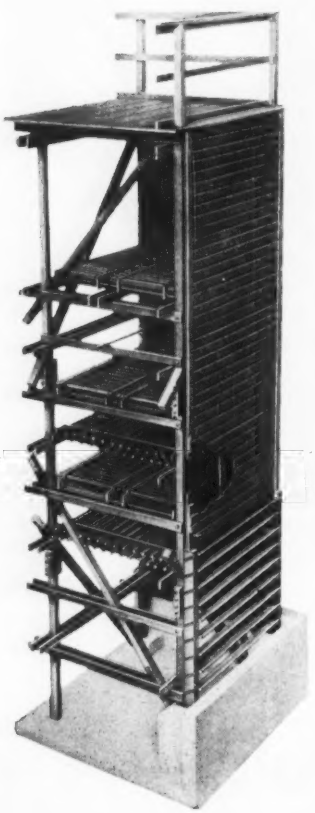
## for STEAM CONDENSING and

## with heat loads from

**Steam Condensing Cycle**
10 Central Station Units
8 Industrial Plants



**Process Cooling Cycle**
13 Petroleum Refineries
10 Chemical Plants
5 Steel Mills
3 A.E.C. Plants
9 Miscellaneous



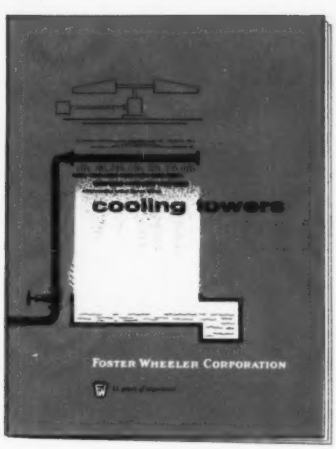
**FEATURES IN BRIEF**

- Water-Mizer Drift Eliminators engineered for maximum efficiency – hold drift losses well below recommended minimum values.
- Full Cone Spray Nozzles provide maximum dispersion with exceptionally low pressure drop.
- Double Diamond Fill Racks designed to expose maximum water surface to counter-flowing air stream.
- Rugged Redwood Framing forms completely independent structure with all stresses transmitted directly to tower foundation.
- Simple, Straight-Line Bracing relieves structural members of horizontal shear stresses.
- Ventilated, Double-Wall Redwood Casing keeps outside dry – minimizes wood deterioration.
- Self-Leveling Interior Posts compensate for irregularities in floor and require no piers or anchors.

# TOWERS have been specified

## PROCESS COOLING CYCLES

## 25,000,000 to 1,050,000,000 btu/hr




Since the recent introduction of the new Foster Wheeler Induced Draft Cooling Tower, 62 units have been sold in eighteen States and nine foreign countries. Ranging in cooling capacity from 25 million btu/hr to 1 billion 50 million btu/hr, these towers cover a wide range of climatic conditions and geographical locations.

Why were Foster Wheeler cooling towers specified for so many new installations? Part of the answer is given in the list of *FW features* at the left — features that contribute to high cooling efficiency, low drift losses, easier installation and exceptionally low maintenance year after year.

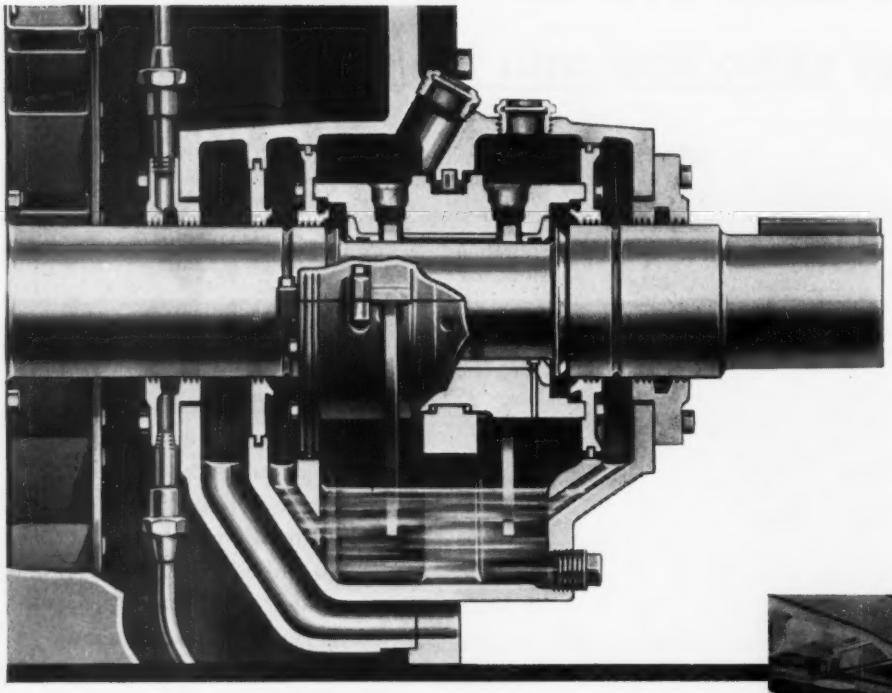
For the *complete story*, send for your free copy of the new, 32-page Cooling Tower Bulletin, CT-57-1, shown at left. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

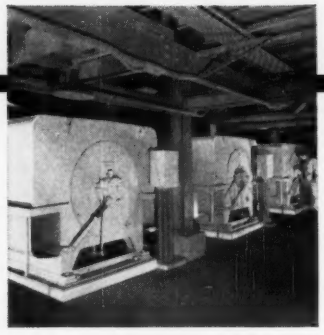
# FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

One of many reasons why **ALLIS-CHALMERS MOTORS**
operate dependably for

## POWER PLANTS





Allis-Chalmers 1750-hp weather-protected motors driving boiler feed pumps.

# Motor Bearing is "extra sealed" with vent

A VENT is seldom a seal . . . but it is in this high speed Allis-Chalmers motor.

Just in case any oil or oil vapor might pass out of the bearing enclosure through the regular seals it can never reach the motor interior. Instead, it enters an annular chamber at the rear of the bearing housing. Pressurized air from the motor fan region is introduced into this pressure chamber and is vented to atmosphere. Positive protection is provided.

### Accessible, Too!

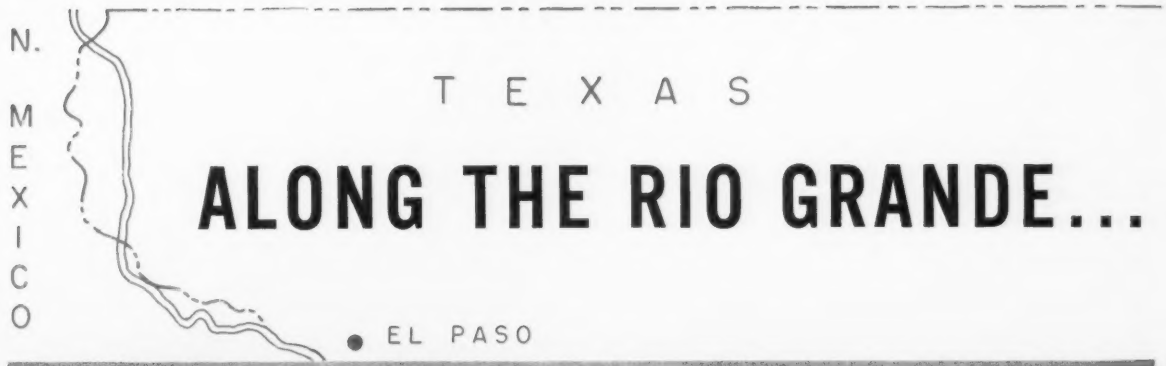
Many man-hours in maintenance are saved because the motor can be inspected and maintained without opening or disturbing the bearing itself. It is only necessary to remove the upper half of the split end shield.

For details on these and other features of Allis-Chalmers motors, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS CHALMERS

**ALLIS CHALMERS**

A-5477




# ALONG THE RIO GRANDE...

The Southwest has become one of the centers of national defense. Here, served by the Rio Grande Station of the El Paso Electric Company, are Fort Bliss, Beaumont General Army Hospital, Biggs Field, White Sands Proving Grounds, Holloman Air Development Center and many strategic industrial firms.

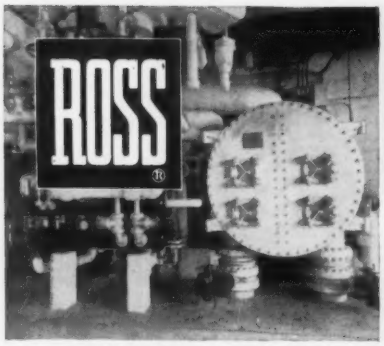
Stone & Webster Engineering Corporation designed and built the original Rio Grande Station which produced 49,000 kilowatts, as well as subsequent additions that raised its capability to 200,000 kilowatts. Currently Stone & Webster is installing another unit with a capability of 50,000 kilowatts which is scheduled to go on the line next year.

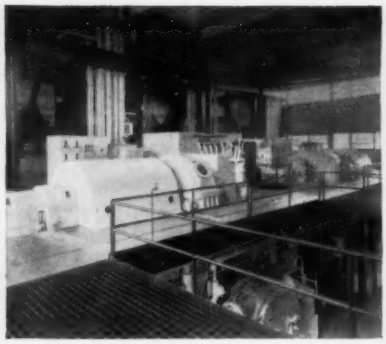
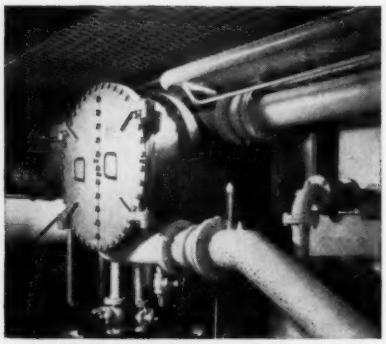
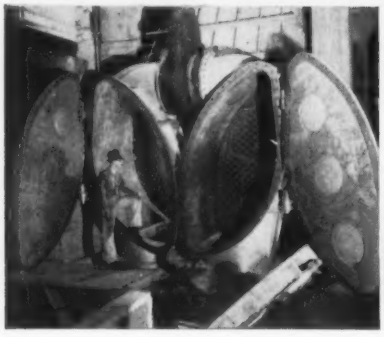
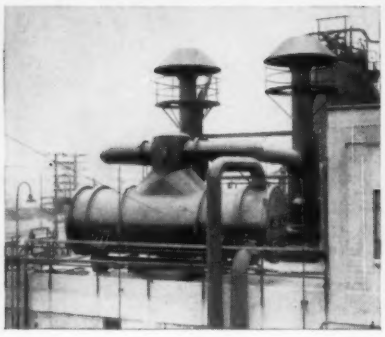
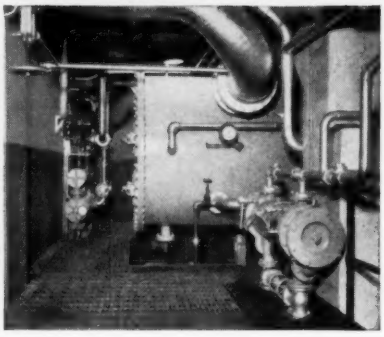
*Write or call us for information as to how our experience may be of assistance to you.*

**STONE & WEBSTER ENGINEERING CORPORATION**

A SUBSIDIARY of STONE & WEBSTER, INC.

New York • Boston • Chicago • Pittsburgh • Houston • San Francisco • Los Angeles • Seattle • Toronto



## *On the subject of Surface Condensers*

# ROSS speaks with 40 years' experience

What are *your* requirements in surface condensers? A single unit or several? Large twin-bank or smaller single-bank type? *Ross is singularly equipped to fill your needs.*

Long a leading producer of all types of heat exchange equipment and condensers, Ross has wide and diversified experience in serving power plants. Starting with the Pearl Harbor Navy Yard installation in 1917, it has continually stressed progressive engineering that has set the pace with many "firsts" in surface condenser design.

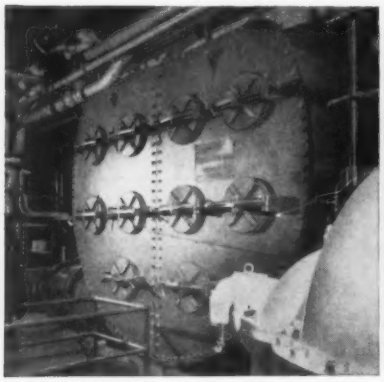
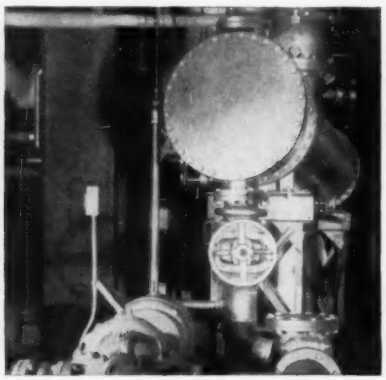
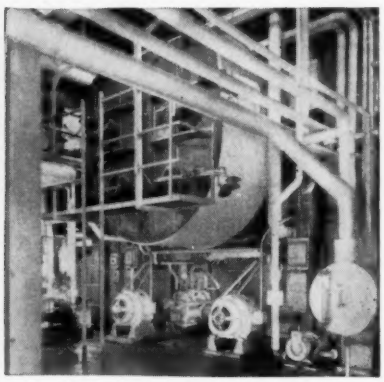
For 40 years, utilities, institutions, office buildings and industries have presented many unique problems to Ross . . . *and found their solution.* Today, Ross has design precedents for virtually every condenser application.

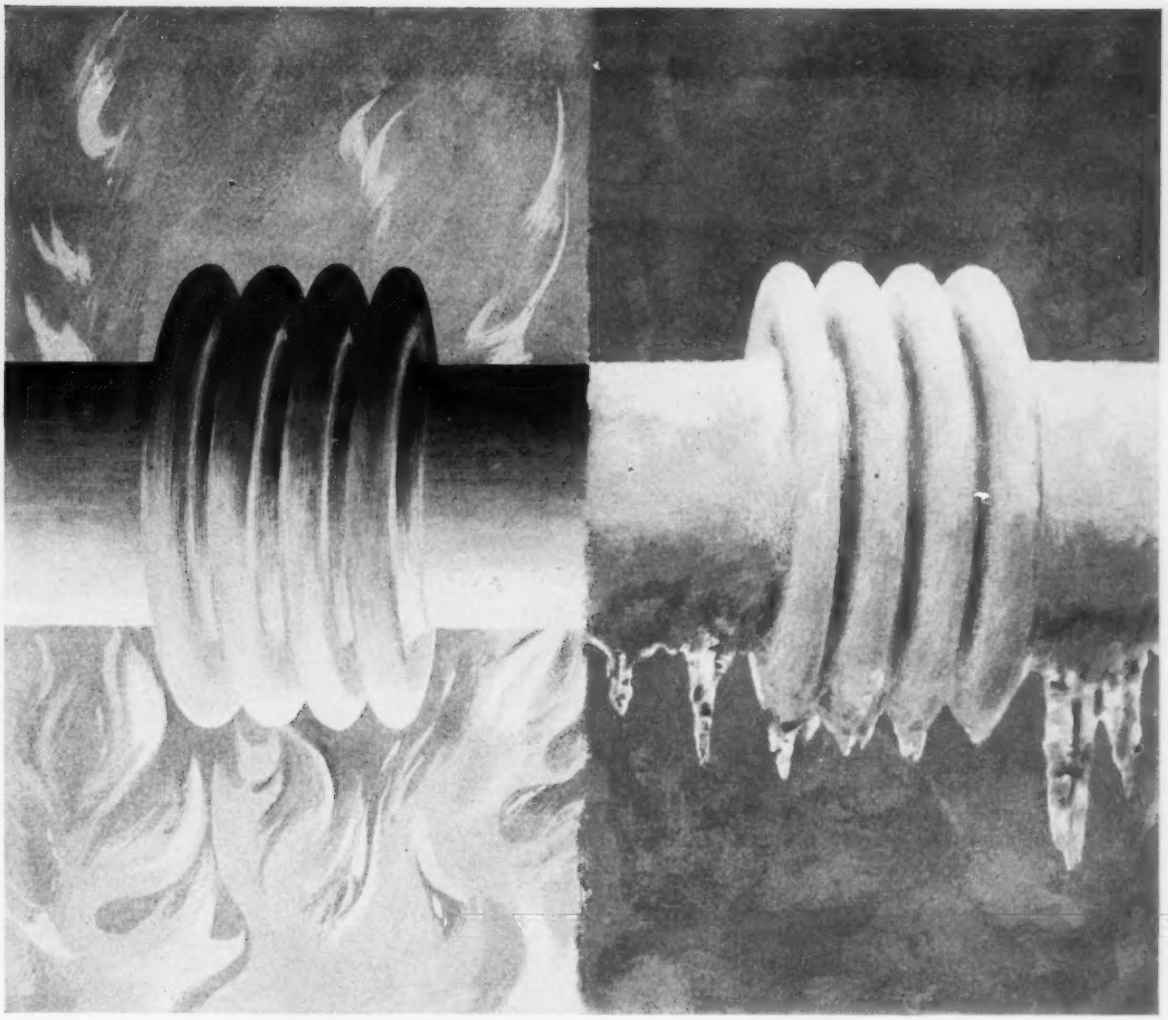
Put this exceptional Ross engineering talent to work for you on *all* your condenser and heat exchanger requirements for power generation. With sales engineering facilities in principal cities, and representatives throughout the nation and abroad, Ross can provide prompt, on-the-spot service anywhere.

Pertinent facts on Ross leadership in surface condenser design are available in Bulletins 8.1K1 and 8.2K1. Write for your copies. Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

**ROSS HEAT EXCHANGER**

Division of AMERICAN-Standard



# HOT OR COLD

## Sola-Flex® joints are designed for temperature extremes

**FROM LIQUID OXYGEN** at –300 F, to extremely hot materials at 2000 F, Sola-Flex bellows and expansion joints are engineered for long periods of rugged service under severe temperature extremes.

In cold oxygen lines, Sola-Flex joints reliably handle high pressures in extended positions and the U-span design offers no internal pockets to conceal dangerous contaminants. In high temperature applications, Sola-Flex joints require no external reinforcement rings, provide an economical solution to expansion problems.

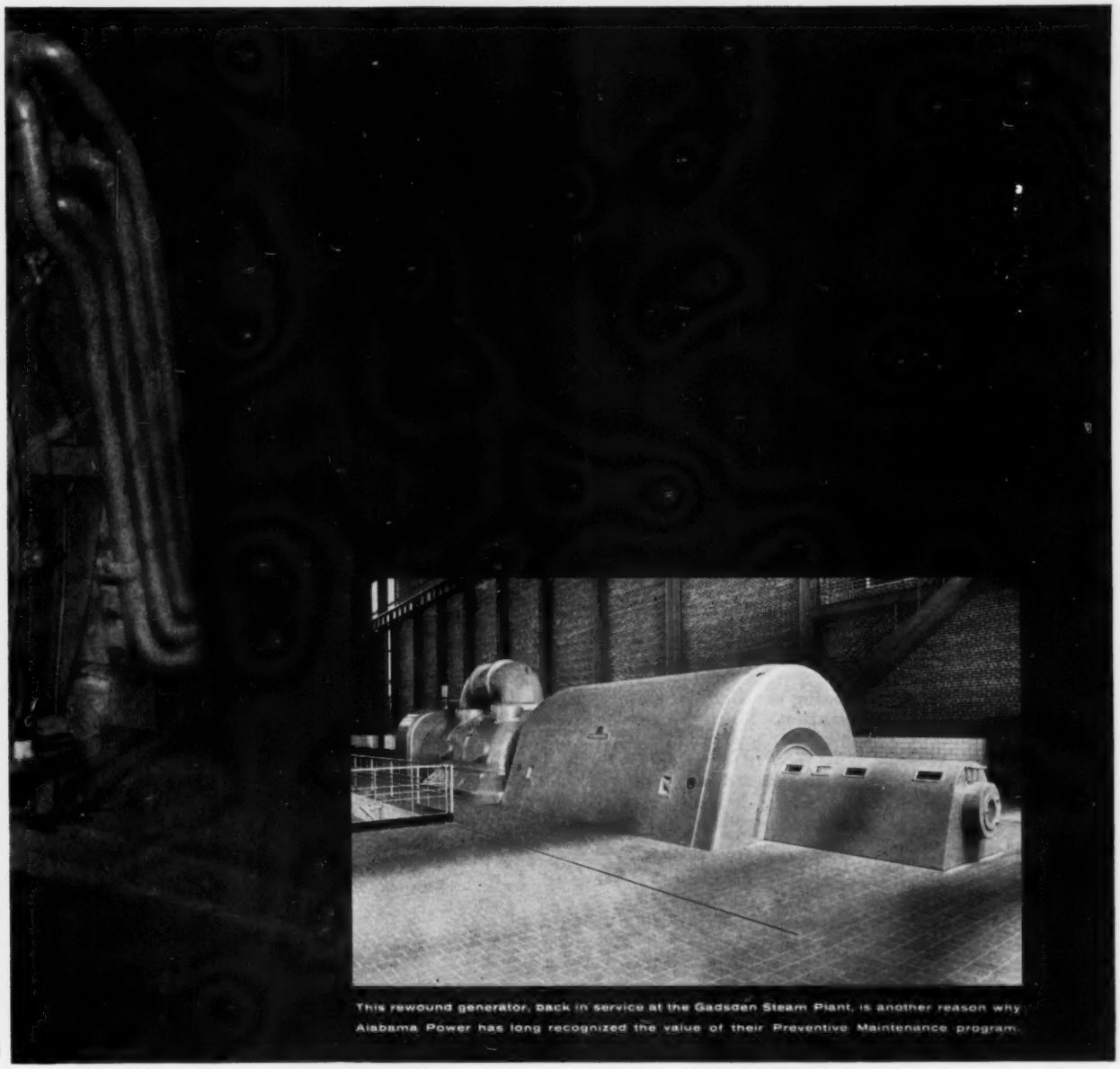
Hot or cold, large or small, high pressure or low—no matter what your particular piping need, experienced Solar engineers can recommend exactly the right expansion joint for you. Write today for the latest Sola-Flex catalog. Department D-61, Solar Aircraft Company, San Diego 12, California.

**Sola-Flex Bellows and Expansion Joints for industry are designed and manufactured by Solar Aircraft Company**

SOLA FLEX®

*Westinghouse Preventive Maintenance at Alabama Power Company*

# FROM COIL ORDER TO COMPLETED REWIND IN 4 WEEKS



This rewound generator, back in service at the Gadsden Steam Plant, is another reason why Alabama Power has long recognized the value of their Preventive Maintenance program.

Westinghouse Preventive Maintenance Inspection Service serves Alabama Power Company, again. When Westinghouse field engineers inspected this 60,000-kw generator in February, 1957, during scheduled overhaul of the generating unit, they found conditions which led to a decision to rewind it during the outage then in progress. Westinghouse was ready with men and materials to do the job.

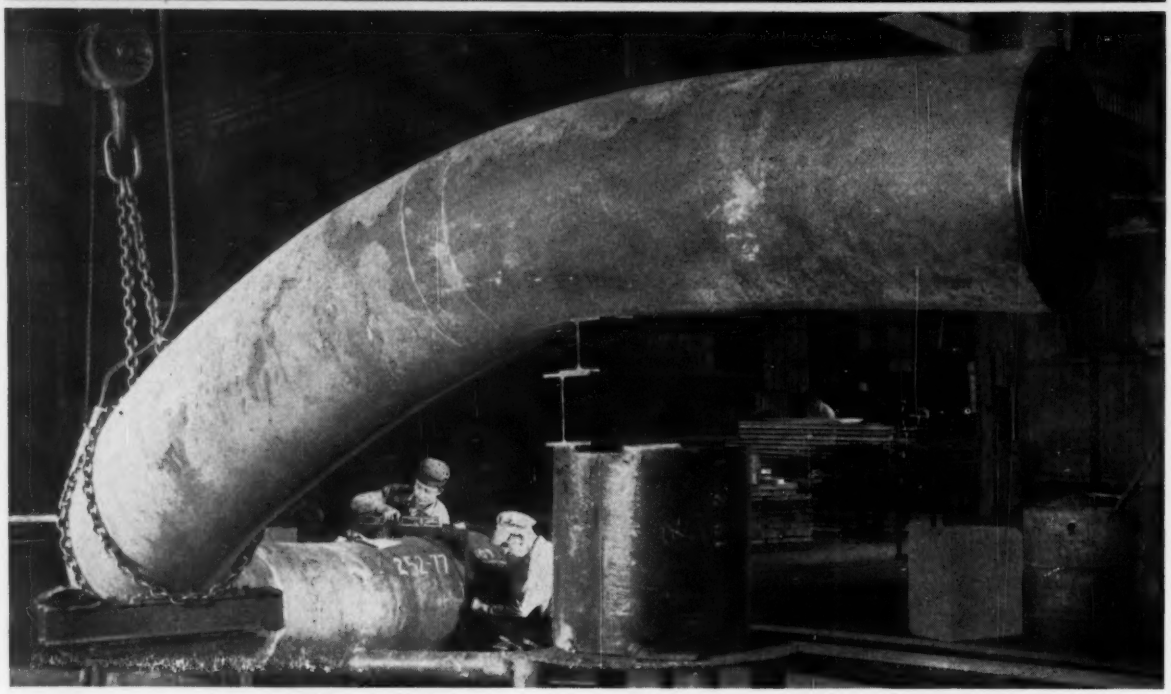
Alabama Power stated the unit couldn't be out of service for more than 5 weeks, or they would suffer additional loss. Westinghouse alerted its personnel, ordered the coils and started working 20 hours a day, 6 days a week, to strip and rewind. The job was completed March 14th, 28 days after the customer order was given.

Skilled, highly trained Westinghouse field personnel will perform preventive maintenance inspection, on-the-spot repairs and modernization to keep your electric apparatus operating at peak efficiency. Nationwide, they are on call 24 hours a day with fast, reliable service.

Contact your Westinghouse salesman, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa. J-95183

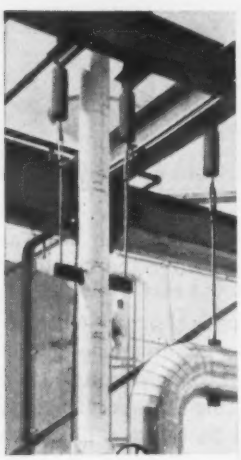
**YOU CAN BE SURE...IF IT'S Westinghouse**

## BLAW-KNOX has what it takes—to provide these products and services



**Large chrome moly pipe being readied for shipment to new generating station.** Making a right angle bend followed by a 24 degree, 18 foot bend in this heavy 27½ inch chrome moly pipe required all the skill and modern facilities of the Blaw-Knox power piping shop. Before shipment, piping is heat-treated and ultrasonically tested with a radar-type device for detection of any defects.

A new Blaw-Knox "6 x 6" Flexibility Matrix Method of computing stresses in power piping systems is now available to consulting engineers, companies, and individuals responsible for the design of power piping systems. By the use of an electronic computer this method cuts calculating time from months to a day; assures full accuracy to six significant figures; and has no limitations on the complexity of the system. Write for further information about our new "6 x 6" Flexibility Matrix Method.



**Two-way control over movement of piping** is provided by Blaw-Knox functional spring hangers with the patented internal swivel action—shown in this modern outdoor generating station. Our experienced engineers are available to both design and make recommendations for your hanger requirements. To get full information, write for Catalog No. 54.

**Each year serious fire strikes one out of every seven** manufacturing firms in this country. Be safe. Let a Blaw-Knox fire-protection engineer study your needs—and explain how you can pay for the system on our lease or deferred payment plan. To get more information send for Bulletin No. 2426—"Fire Can Destroy Your Business."

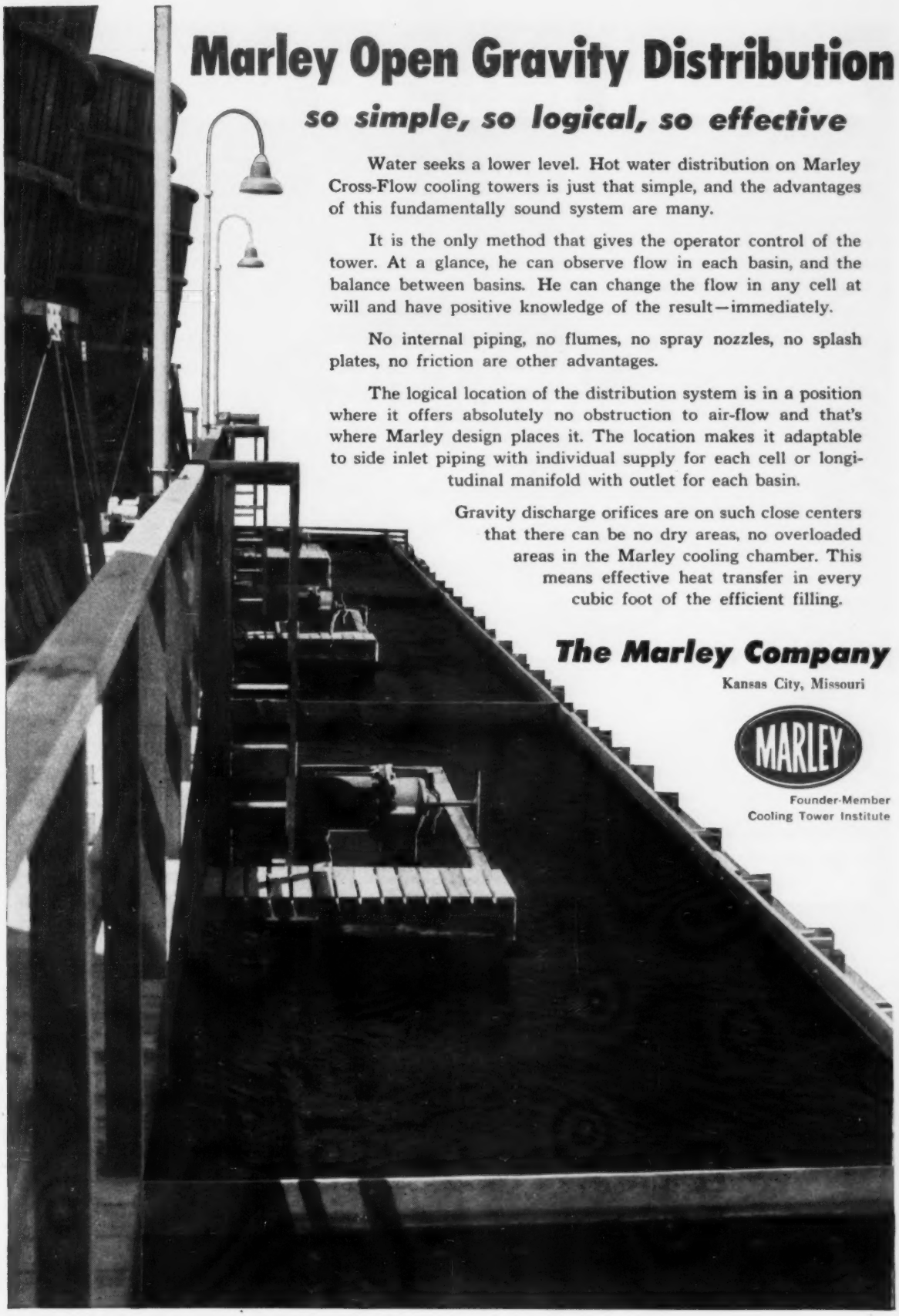
BLAW-KNOX

**BLAW-KNOX COMPANY**

*Power Piping and Sprinkler Division*

*829 Beaver Avenue • Pittsburgh 33, Pennsylvania*

**Complete facilities for prefabrication and erection of piping systems for all pressures and temperatures . . . complete line of standard and custom-engineered pipe hangers, supports and vibration eliminators . . . complete line of automatic sprinkler systems for standard and special hazards**



# Marley Open Gravity Distribution

## *so simple, so logical, so effective*

Water seeks a lower level. Hot water distribution on Marley Cross-Flow cooling towers is just that simple, and the advantages of this fundamentally sound system are many.

It is the only method that gives the operator control of the tower. At a glance, he can observe flow in each basin, and the balance between basins. He can change the flow in any cell at will and have positive knowledge of the result—immediately.

No internal piping, no flumes, no spray nozzles, no splash plates, no friction are other advantages.

The logical location of the distribution system is in a position where it offers absolutely no obstruction to air-flow and that's where Marley design places it. The location makes it adaptable to side inlet piping with individual supply for each cell or longitudinal manifold with outlet for each basin.

Gravity discharge orifices are on such close centers that there can be no dry areas, no overloaded areas in the Marley cooling chamber. This means effective heat transfer in every cubic foot of the efficient filling.

***The Marley Company***

Kansas City, Missouri

MARLEY

Founder-Member
Cooling Tower Institute

**A** Two extension coil springs hold assembly against shaft.

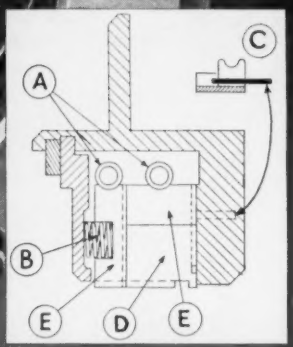
**B** Axial compression springs exert constant positive pressure toward the sealing face.

**C** Key and pin assemblies lock carbon segments against rotation.

# KOPPERS CIRCUMFERENTIAL SEAL

## PROVIDES UP TO 2000 hrs. OF PERFORMANCE

**CAN USE LESS THAN 5 h.p.**




**D** Flexible sealing segments permit seal to achieve same circularity as shaft.

**E** Straight-cut joints are covered and sealed by segmental cover ring and segmental back ring.

A number of finite joint gaps allow for ring wear.

Koppers Circumferential Seal is a segmented carbon seal ring with straight-cut joints. Its design can be modified to use step type joints or step seal joints. Primarily a gas seal, the Koppers Circumferential Seal will seal liquids if the geometry of the shaft mating faces is changed.

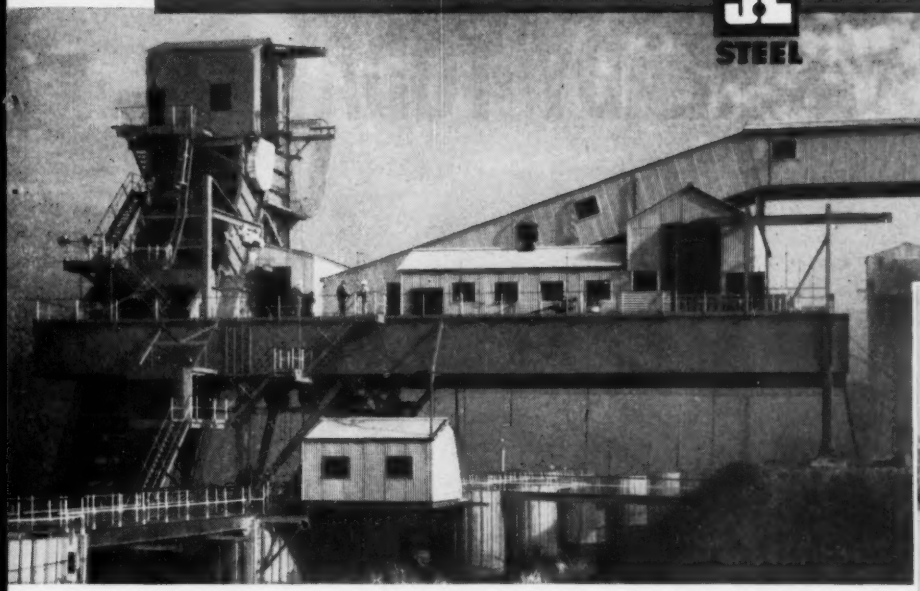
Koppers Circumferential Seals are one of a large variety of seals designed and manufactured by Koppers for every industrial use. Because of this complete line, Koppers can recommend, without bias, the seal best suited to your specific application. And Koppers continuous development and testing of new designs and new materials assure you of the most advanced, most efficient seals for your purpose. If you have a sealing problem, write to the KOPPERS COMPANY, INC., Metal Products Division, Piston Ring and Seal Department, 2108 Scott St., Baltimore 3, Maryland.

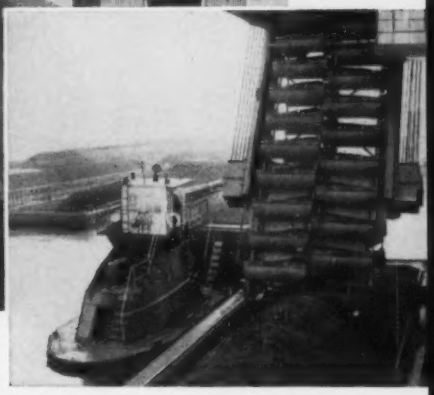
*Engineered* Products
Sold with *Service*

KOPPERS

**MECHANICAL SHAFT SEALS**

# Another H&P SPEED CHAMPION for J&L Jones & Laughlin STEEL





*The new Heyl & Patterson Barge Unloader, coal conveyors and coal bins at the Coal Preparation Plant of the Jones & Laughlin Steel Corp., East Fredericktown, Pa. All movements of the barge and unloader are controlled by one man from the operator's cab. This installation is a virtual duplicate of one operating since 1951 at J & L's Aliquippa Works.*

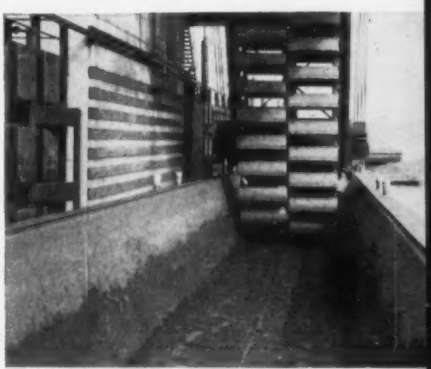
*Coal is handled by this Unloader featuring an 83'-long bucket elevator. As the barge is pulled past, each of the continually moving buckets takes a 1400-pound bite from the coal pile and carries it to the top to be discharged on a belt conveyor. The hoist can be raised or lowered 34 feet.*

**This newest Bucket Elevator Barge Unloader assures low-cost operation at high capacity. It also features the famous built-in H & P reliability.**

**Heyl & Patterson has built numerous bulk material loading, unloading and handling systems. Whatever your industry . . . coal, steel, chemical, utility, transportation . . . we suggest you call an H & P Sales Engineer to discuss your bulk material handling problems, and remember . . .**

***When Experience Counts . . .***
***Count on Heyl & Patterson!***

70 YEARS OF SERVICE

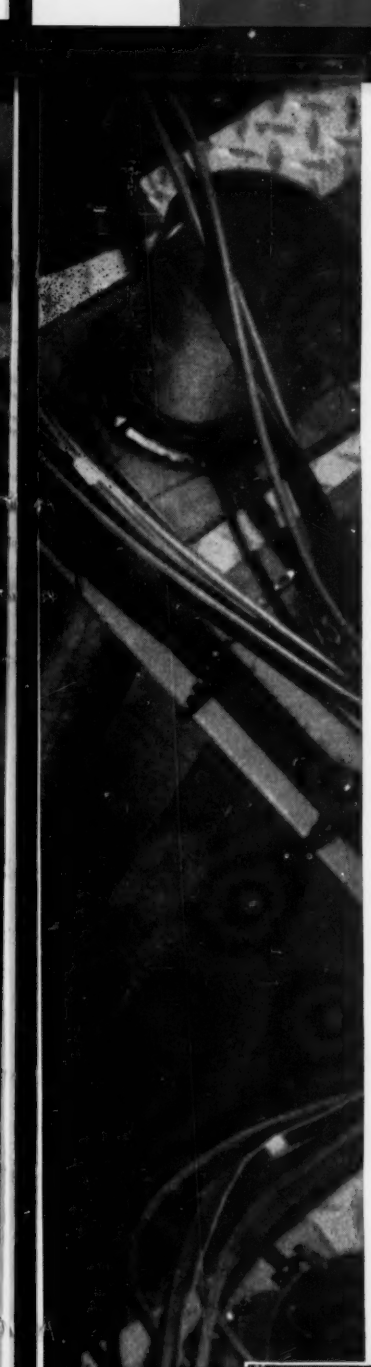


*Un-retouched photograph of a barge on its third and final pass indicates the proficiency of the Unloader at cleaning out a barge without damage to it. Because coal is removed so completely, no clean-up men are needed.*

## Heyl & Patterson INC.

**55 FORT PITT BLVD. • PITTSBURGH 22, PA.**

POWER FROM THE ATOM
IS READY TODAY



## ALCO's pressurized-water plant offers safe, stable power to 20,000 kw for high-cost fuel areas

Basic design and engineering for the ALCO atomic plant are complete. Experience with the Army Package Power Reactor — built by ALCO under the first fixed-price contract for a plant awarded by the AEC — has contributed to the commercial plant design. Because of this, the plant is not experimental. It can provide economical power in remote areas where fossil fuels are expensive. And ALCO's own criticality facility will make tests on specific reactors to insure their performance — before they reach the plant site.

Investigate the ALCO atomic plant. Technical analysis is available, at no obligation, on site selection, design specifics and operating costs.

## ALCO nuclear components result of experience, leadership

ALCO's leadership in thermal engineering and manufacturing has produced atomic plant components for almost all reactor types. ALCO has designed and built components for the *Nautilus*, the APPR, sodium reactors and various AEC production installations. Along with this extensive experience, ALCO has complete facilities to insure continued leadership. These include its new thermal laboratory, mechanical, welding and metallurgical laboratories, criticality facility, and an electronic-computer center for thermal, mechanical and nuclear problems.

***Here is a list of ALCO atomic plant components that are available:***

**reactors • reactor vessels • control-rod drive mechanisms • steam generators pressurizers • core-support structures • core removal and handling equipment regenerative and non-regenerative exchangers • liquid metal exchangers decay exchangers • special heat-transfer equipment.**

For information, including the brochure "Competitive Power from the Atom," write Atomic Projects, Dept. AE-1, P.O. Box 1065, Schenectady 1, N. Y.

**ALCO** **ALCO PRODUCTS, INC.**
**NEW YORK**
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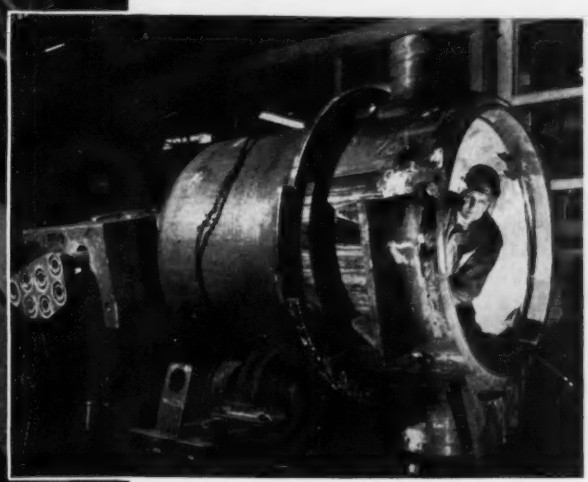
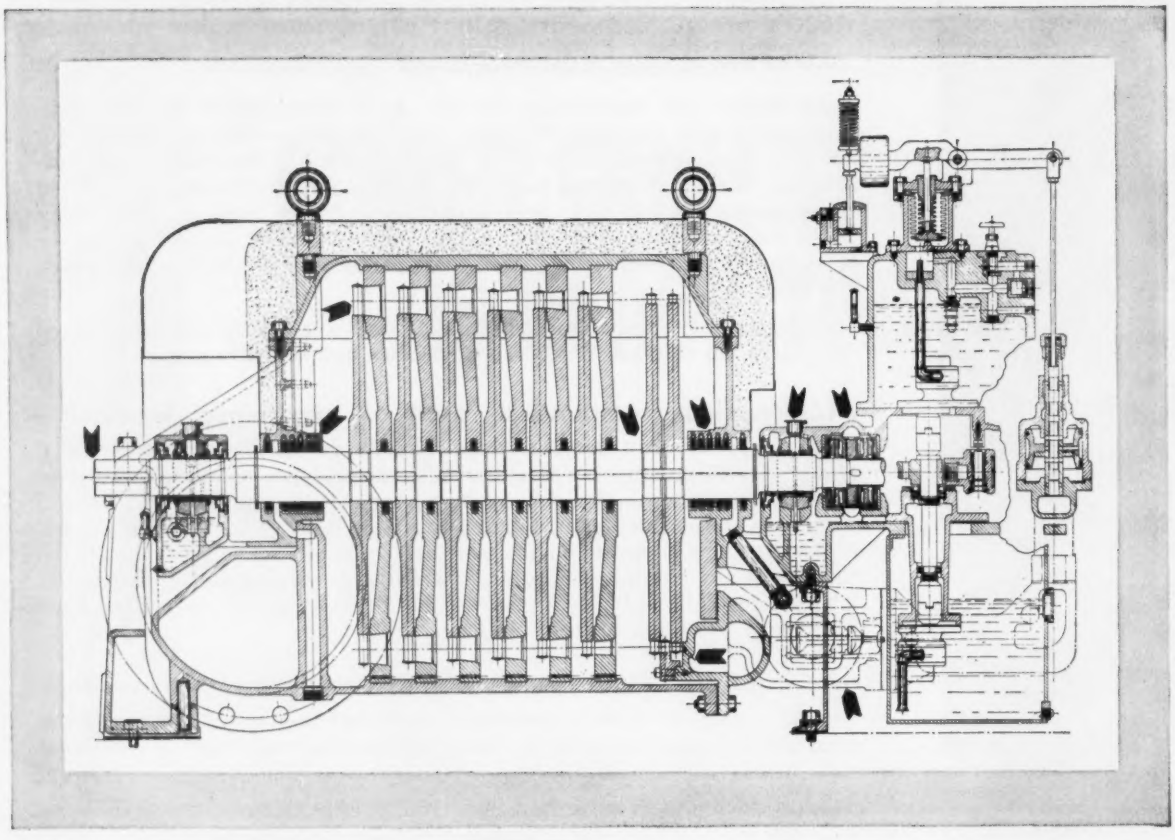
*Locomotives • Diesel Engines • Nuclear Reactors • Heat Exchangers*
*Springs • Steel Pipe • Forgings • Weldments • Oil-Field Equipment*



**Reactor vessel for APPR** was built of stainless steel at ALCO's Dunkirk, N. Y. plant.

**Cutaway of ALCO steam generator** for pressurized-water atomic plants.

**Technician checks APPR reactor core** prior to tests in ALCO's criticality facility at Schenectady, N. Y.



# ANOTHER INSIDE STORY OF THE UNIVERSAL ACCEPTANCE OF MURRAY MULTI-STAGE TURBINES IN THE MECHANICAL DRIVE FIELD

- Husky accurately machined shaft.
- Discs shrunk and keyed in place.
- Stainless steel nozzles and blading throughout.
- Spherical seated sleeve bearings.
- Kingsbury thrust bearing.
- Center line support.
- Carbon ring gland seals.
- Double seated balanced governor valve — stellited.
- Choice of speed governors from simple mechanical type to precision oil relay.
- Bolt type overspeed trip governor.
- Steam conditions to 600 PSIG and 750°F.
- Condensing or non-condensing.

Our nearest representative will gladly help you solve your mechanical drive turbine requirements. Just write to Murray Iron Works Company, Burlington, Iowa, for his name.

★ ★ **Murray Turbines** ★ ★

**Walworth iron body saddle type wedge gate valves** are suitable for use on steam, water, gas, gasoline, oil, and many process lines. They are easy to take apart, simple to service, fast to reassemble. Walworth saddle-type valves are available in a wide range of sizes in eleven different combinations of design and materials including bronze-mounted, all-iron, and ni-resist; with both flanged and screwed ends. All types can be repacked under pressure when fully opened or fully closed.

Ask your local Walworth distributor to give you complete information or, write for circular.

**WALWORTH**

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*DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD*

*WALWORTH SUBSIDIARIES:* ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO. SOUTHWEST FABRICATING & WELDING CO., INC. • M&H VALVE & FITTINGS CO. • WALWORTH COMPANY OF CANADA, LTD.

# PRIMARY UNIT SUBSTATIONS

# CUSTOM BUILT FOR YOU —AT NO EXTRA COST

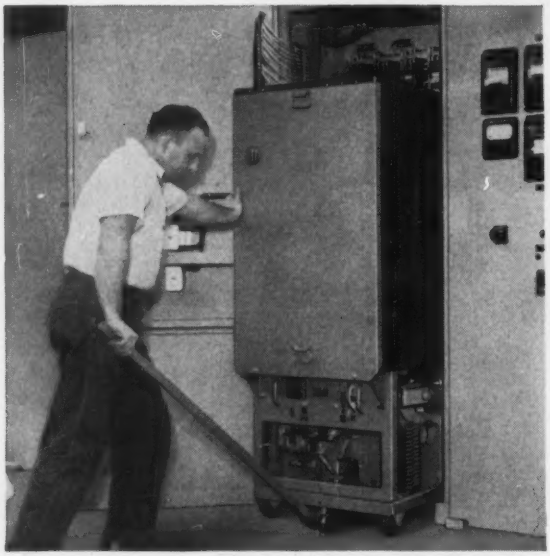
Here at I-T-E, complete primary unit substations are custom designed and engineered to meet your particular requirements. I-T-E engineers skillfully knit together quality I-T-E substation components in a way to give you the advantages of versatility, reliability, safety and convenience.

Particular emphasis is placed on ease of installation to meet all your requirements for growth and relocation, with full regard to an appearance that fits well into your surroundings.

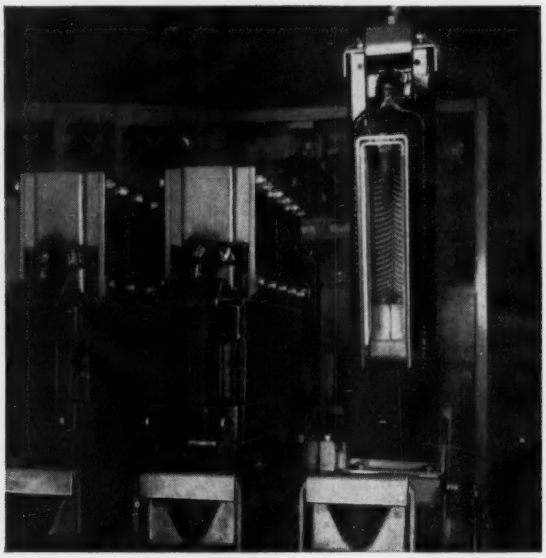
Typical I-T-E quality manufacturing standards further insure that your substation will give you the maximum reliability and performance at the lowest cost. Delivery can be made in accordance with your own construction schedule. You can save time, trouble and money in completing the final job.

I-T-E primary unit substations are available for any application and in any standard rating. For details, call the I-T-E sales office near you. Or write I-T-E Circuit Breaker Co., 19th & Hamilton Sts., Philadelphia 30, Pa.

## Engineered to insure the best value

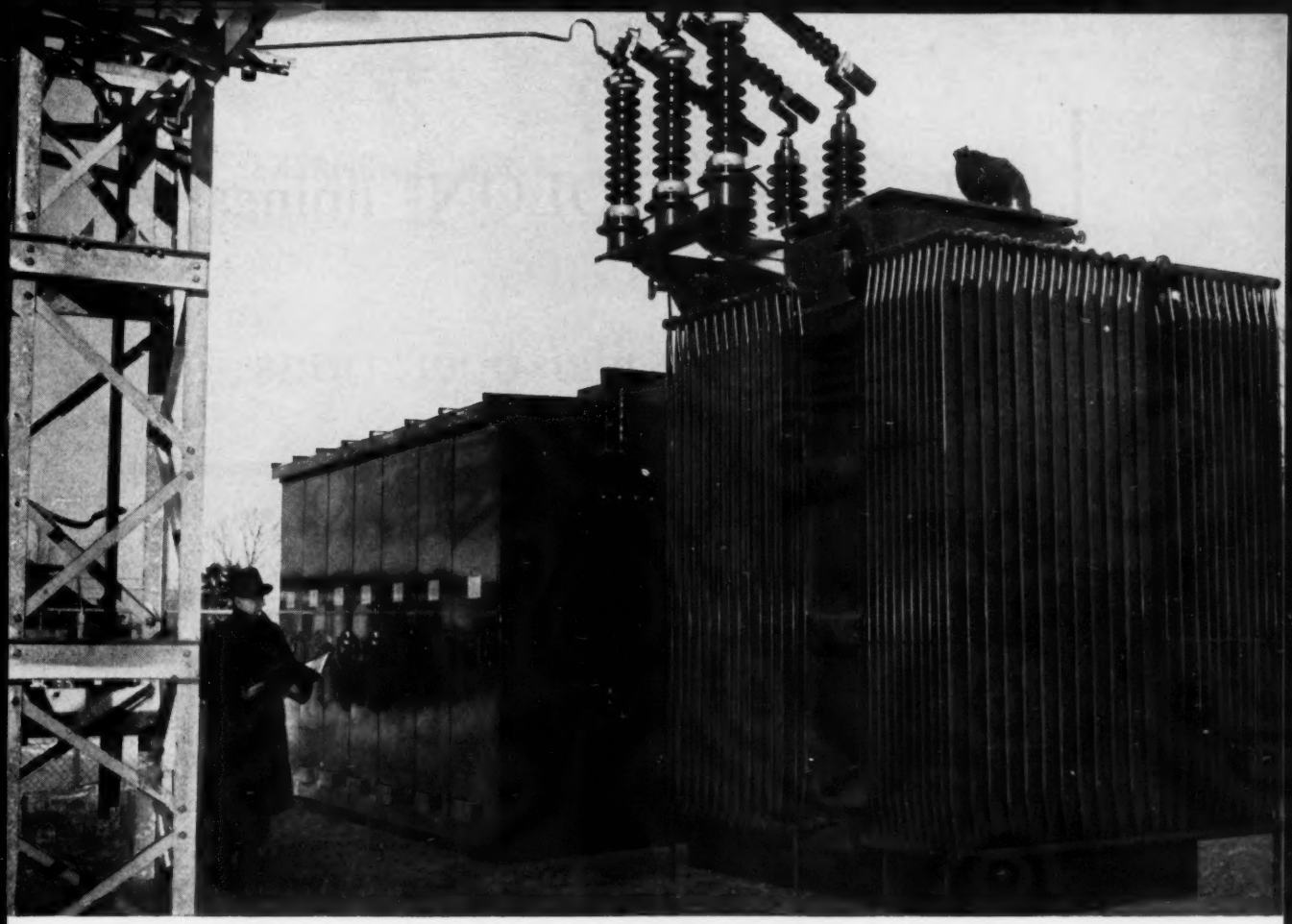


**Horizontal drawout air circuit breakers.** Even heavy 13.8-kv circuit breakers roll out easily on permanently attached wheels. Safety shutters automatically close over bus openings when breaker is moved to test position or from enclosure.

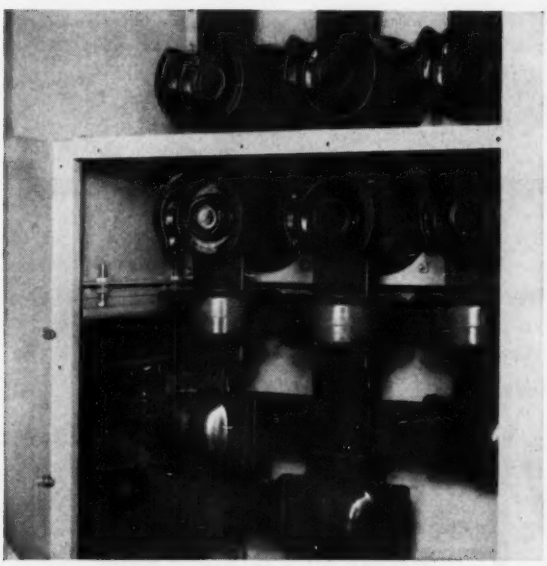


**Positive arc interruption.** Double coil, closed iron magnetic circuit produces intense magnetic effect, drives arc rapidly and uniformly between plates in arc chute, where it is extinguished, giving faster interruption, longer arc chute life.

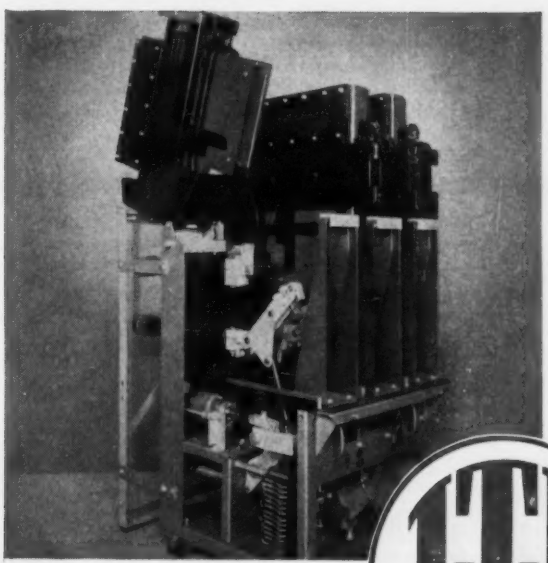
**I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division**



# and the most reliable performance



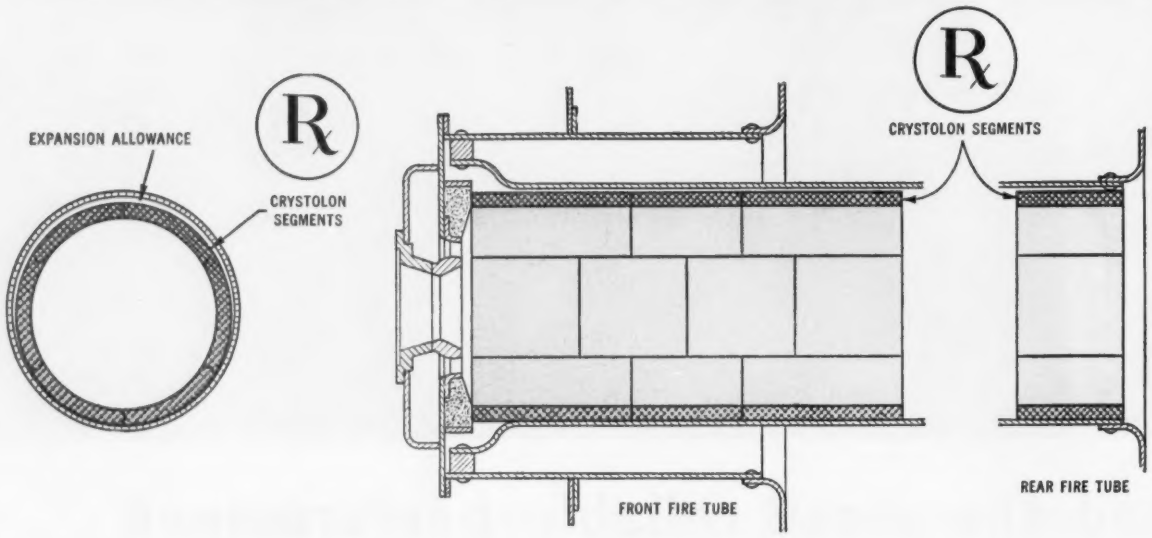
**Fully isolated main bus with flame-retardant insulation.** Bus is held in alignment against short circuit stress by porcelain bus supports. Flame-retardant insulation covers entire bus, including porcelain primary disconnect housings.



**Simplified maintenance.** Pivoting arc chutes simplify routine inspection and upkeep. Auxiliary devices are positioned to permit easy access.

IN CANADA: EASTERN POWER DEVICES LTD.

# How CRYSTOLON* linings pay off in packaged boiler operations




***In Fire Tube Packaged Boilers*** the swirling action of the flame causes particularly heavy erosive and abrasive attacks on the refractory lining. CRYSTOLON refractories, with their high resistance to abrasion and erosion, make the ideal lining material. Also, their ability to take up and release heat rapidly improves combustion and flame characteristics — a further advantage for over-all boiler efficiency.

In boilers of this type use arch brick for larger boilers, tongue-and-grooved segments for smaller boilers. In water wall packaged boilers use CRYSTOLON armor block at the grate level and CRYSTOLON brick and cement to protect the bridge wall,

Norton CRYSTOLON refractories, *engineered and prescribed* for better boiler operation, are characterized by exceptional hot strength, high refractoriness and thermal conductivity and great resistance to slag penetration, spalling and abrasion. Providing maximum protection against the mechanical and chemical attacks of a wide variety of fuels, they eliminate many costly repairs to grates and settings, as well as reducing down-time.

***Send for booklet***

describing how Norton refractories supply money-saving Rx's for your boiler applications. Write for your copy of *Refractories for Heat and Power* to NORTON COMPANY, 451 New Bond St., Worcester 6, Mass.

**NORTON**

**REFRACTORIES**

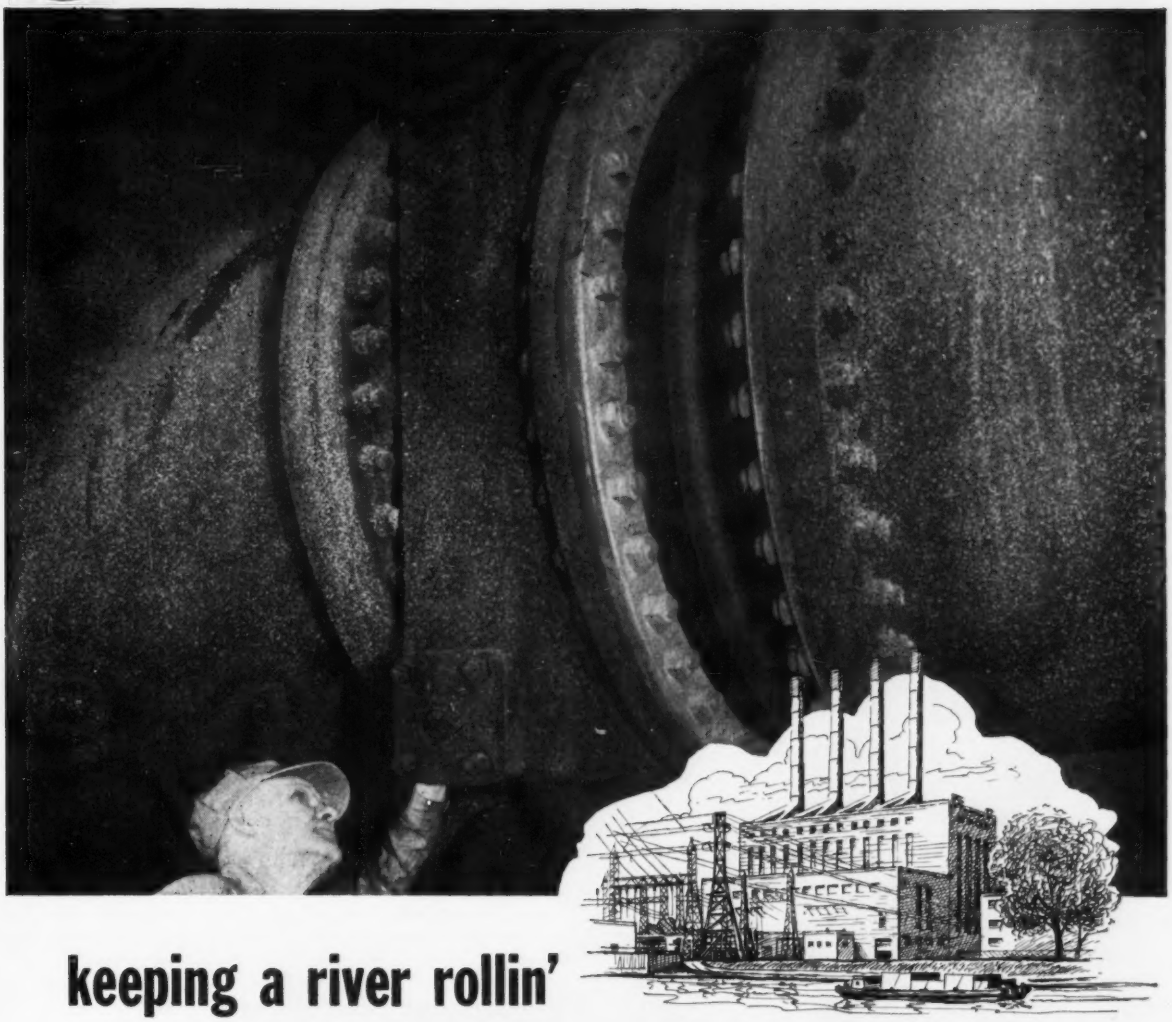
**Engineered... Rx ...Prescribed**

***Making better products... to make your products better***

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

US RUBBER

EXPANSION JOINTS



# keeping a river rollin' and the pipes from rockin'

A river of 390,000 gallons of water per minute rolls through the four surface condensers in Niagara Mohawk Power's plant at Oswego, New York. Here is generated enough power to heat 384,000 household steam irons every hour. Ravenous furnaces consume 3600 tons of coal every 24 hours at full load.

The piping in Niagara's condenser system can't rock or rattle itself to death despite the tremendous capacities and pressures encountered. U. S. Rubber Expansion Joints are the flexible connections that allow the pipes to give and take, to literally ride with the punch.

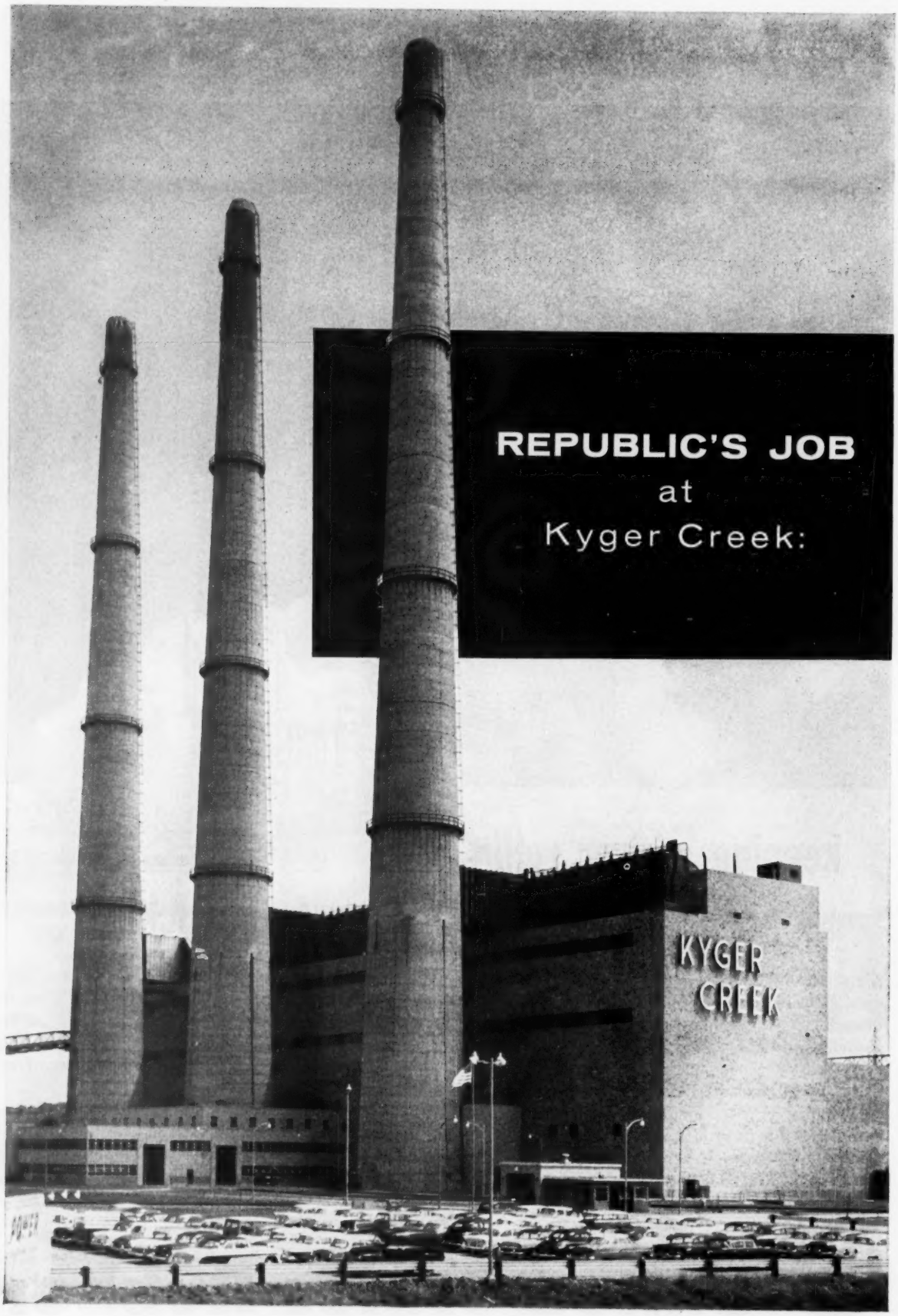
"These Expansion Joints were installed in 1940," says the plant superintendent, "and they've never given us trouble. We use them in sizes from as small as 6" all the way up to 48", and at water temperatures up to 170 degrees Fahrenheit. We know we will get many more years' wear out of them."

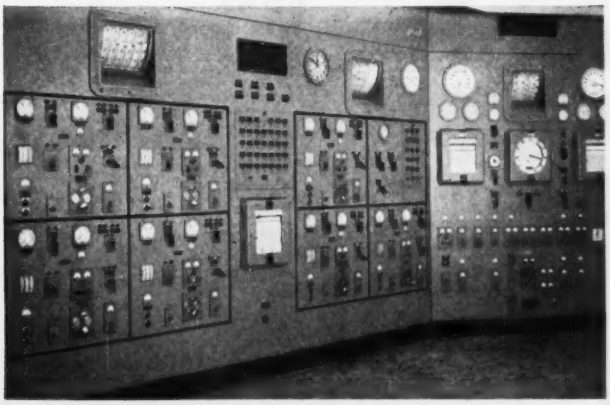
To absorb excess stresses due to expansion and contraction, to insulate against vibration, take care of misalignment, specify U. S. Expansion Joints. They are available at any of the 28 "U.S." District Sales Offices, or write us at Rockefeller Center, New York 20, N. Y.

US RUBBER

Mechanical Goods Division

**United States Rubber**


REPUBLIC'S JOB
at
Kyger Creek:
KYGER
CREEK



One of the five control centers where an "Electronic Master" automatically integrates data and master-loads pneumatic power operators throughout the unit. Manual operation of any function can be taken over by the man on duty at a moment's notice.

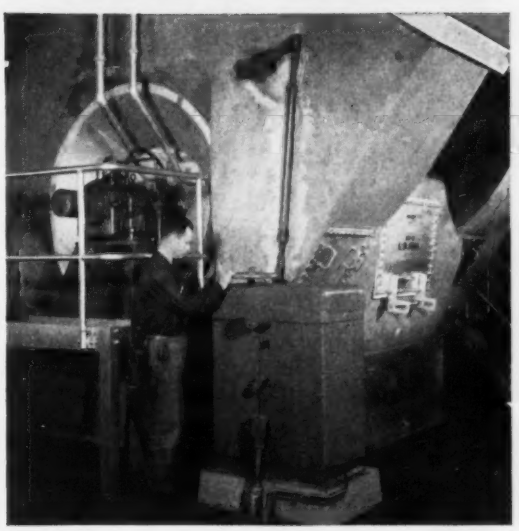
Primary air and coal to each pulverizer (7 per boiler) is pneumatically adjusted to each load by the "Electronic Master," which always holds the desired fuel/air ratio. Electronic loadings can be remotely adjusted to regulate the portion of total fuel fired by each pulverizer. An electronic fuel splitter and fuel totalizer automatically divide the coal in the desired ratios among all pulverizers in operation, permitting the addition or removal of pulverizers from the line with minimum disturbances.

# control five 1,400,000 lb./hr. boilers —automatically

Kyger Creek Power Plant of the Ohio Valley Electric Corp. produces a million kilowatts for our national atomic program — which makes it one of the most critical power plants in the world.

To keep each of the five huge boilers at top efficiency at all loads, it is necessary to regulate 7 coal pulverizers, 14 burners, 2 F.D. fans, 2 I.D. fans, and many shut-off and regulating dampers as if they were a single unit. The Republic *load* sensing combustion control with the "Electronic Master" keeps tabs on all these inter-related functions. This system makes sure that every change in steam flow is countered with the corrected fuel, air and draft settings *before the load change produces a change in steam pressure.* A follow-up *pressure* control system makes final corrections in control signals (if needed) to hold pressure fluctuations near zero.

Kyger Creek Plant is unusually efficient (7 lb. steam per kwhr) and is one of the country's largest steam plants, but the Kyger Creek combustion control problems are the same ones encountered in any plant striving for stability and peak efficiency. Republic's experience with plants of all sizes, all pressure and temperature ranges, and all load characteristics is your best guarantee of getting all the premium performance built into your major equipment. Never assume any proposal is *best* until you have checked with Republic engineers; they can save you operating, performance and maintenance problems for the full life of your plant.



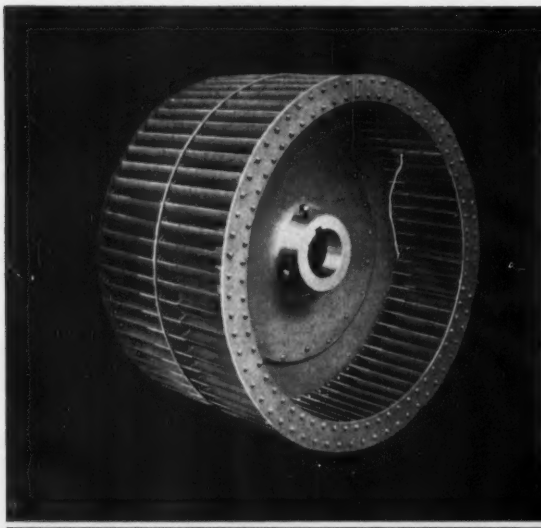
To permit furnace pressure regulation without upsetting combustion air supply, I.D. fans (above) are interlocked with the F.D. fans through the furnace pressure and air flow regulators. I.D. fans are needed only 5% of the time. All fans are constant speed with inlet vane controls, and can be isolated by means of remotely-operated shutoff dampers.

**REPUBLIC FLOW METERS CO.**

*A Subsidiary of Rockwell Manufacturing Company*

2240 Diversey Parkway • Chicago 47, Illinois

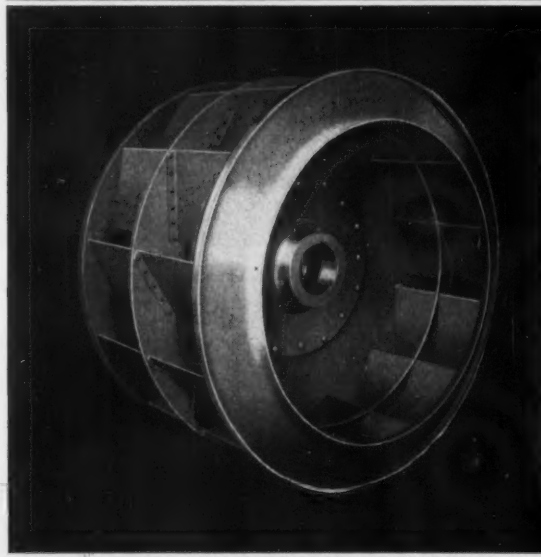
# American Blower Fan Wheels



## SIROCCO WHEELS

**for forced and induced draft duty**

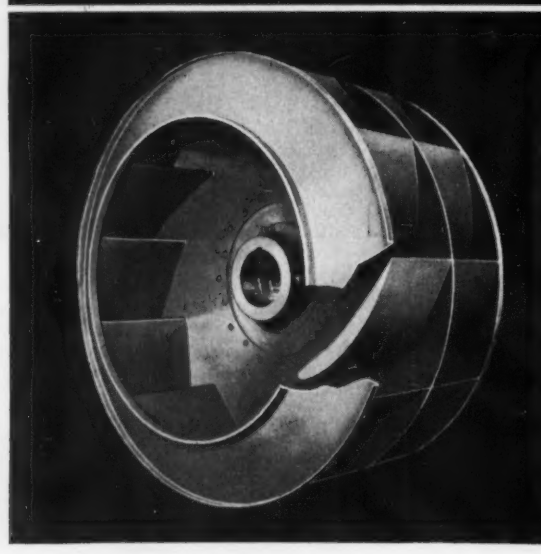
- For balanced draft or pressurized furnace
- Low tip speed
- Die-formed, forwardly inclined blades and heavy streamline inlets
- Used in power plants the world over



## AHS WHEELS

**for forced and induced draft duty**

- Backwardly inclined, nonoverloading horsepower characteristic
- For given duty operates at higher R.P.M.
- Single thickness flat or curved blade
- Heavy rolled streamline inlets

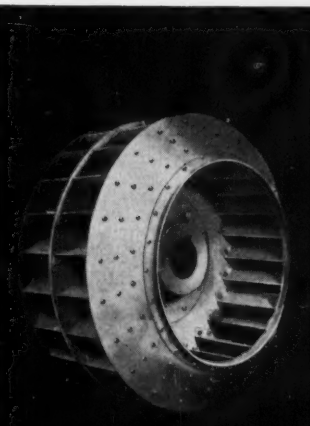


## AIRFOIL BLADE WHEELS

**primarily for forced draft duty**

- Blades are of airfoil cross section, die formed and reinforced as required
- High mechanical and static efficiency
- Nonoverloading power characteristic
- Available with vanes and/or boxes

# Meet Peak Efficiency Standards

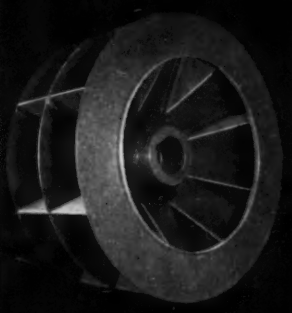


*Radial tip blade wheel*

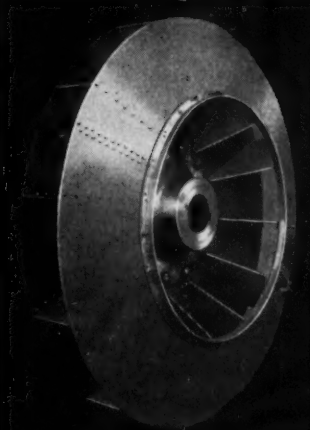
**RADIAL BLADE WHEELS**

**for forced, induced and gas recirculating duties**

- Pressure characteristic favorable to gas recirculating application where unusual system pressures prevail
- Designed for severe temperature and pressure duty
- Available with straight radial or radial tip blades



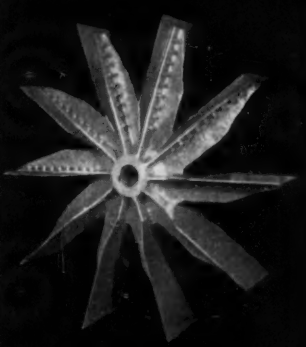
*Straight radial blade wheel*



*Rim type wheel for primary air fans*

**SINGLE INLET RADIAL BLADE WHEELS FOR PRIMARY AIR, VENT, AND OVER FIRE DUTY**

- Designed for high temperature, high pressure applications
- Radial or backwardly inclined blades, single inlet
- Over 1200 primary air fans in operation



*Rimless wheel for vent and over fire fans*

IF YOUR plans include mechanical-draft equipment—for new installations or as replacements—consult your American Blower sales engineer. He can give you helpful information on job-fitted American Blower equipment to meet your power-plant requirements. Call our nearest branch office or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ont.

**AMERICAN BLOWER**

Division of AMERICAN-Standard

QUALITY PROTECTS YOUR INVESTMENT . . . AMERICAN-Standard QUALITY IS AVAILABLE AT NO EXTRA COST

# Greenlee cuts steam costs 18%-20% burning coal the modern way

## Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

## *facts* you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

Expanding facilities at Greenlee Bros. & Company, Rockford, Illinois, created a problem common to many growing firms. The Company's three old boilers had to operate continually at maximum capacity, so that a forced outage could hurt plant production. In addition, peak load operation with outmoded equipment resulted in high fuel costs.

While the newest boiler was retained, Greenlee replaced the other two with modern high-capacity units, including stokers, up-to-date controls and other equipment for more efficient operation. A new, pneumatic ash handling system was installed. Today Greenlee is getting 10%-20% more steam for each pound of coal burned and steam costs are down 18%-20%, saving Greenlee thousands of dollars every year.

*For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.*

BITUMINOUS COAL INSTITUTE

Southern Building • Washington 5, D. C.

# 6 ADVANTAGES OF A. P. GREEN PLASTIC AND CASTABLE REFRACTORIES IN WATERTUBE BOILERS

### MONOLITHIC CONSTRUCTION

A monolithic refractory lining, properly installed, gives better combustion efficiency and longer, more trouble-free service than any other type lining.

### ANCHORED FURNACE LININGS

A. P. Green "floating" anchors hold the refractory lining securely against the casing and permit free expansion and contraction movement.

### AIR-COOLED—SECTIONALLY SUPPORTED WALLS

A. P. Green offers a simple design for air-cooled walls—no special tile are required. Provision for recovery of preheated air can be made. Alloy supporting plates are available for use in extremely high walls, over stoker arches, and burner openings, permitting replacement of any section without disturbing the adjacent areas.

### LESS HEAT LOSS THROUGH WALLS

The low thermal conductivity of A. P. Green plastic and refractory castables means less heat loss through the walls, greater efficiency, and more protection for the outer casing of the boiler.

### LOWER INSTALLATION COSTS

Special shapes are eliminated . . . expensive, time-consuming brick cutting is not necessary. With proper supervision, the installation can be done by average labor.

### EXPERIENCED DISTRIBUTORS—QUALITY WORKMANSHIP

An authorized A. P. Green distributor, trained in refractory problems, is close to your job to give you the kind of quality workmanship your refractory job demands. He is backed by the engineering staff of the A. P. Green Fire Brick Company.

A. P. Green REFRACTORY PRODUCTS

**A. P. GREEN FIRE BRICK COMPANY**
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*Distributors in the Principal Cities of the World*

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**"A. P. Green Refractory Linings for Watertube Boilers."**

NAME_____

COMPANY NAME_____

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CITY_____ STATE_____

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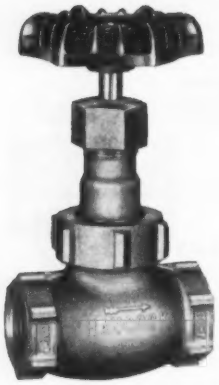
# THIS "ACT" COSTS $10.00 AN HOUR . . . AND IT'S NO COMEDY!



Maintenance costs today make ordinary bronze valves an expensive gamble. Such valves with renewable composition seats and discs require frequent maintenance – piping systems out of service – unnecessary labor. And, the cost of a new disc is only the beginning!

You can eliminate both the expense and the problem. Use Hancock Bronze Valves with *superhard* "500 Brinell" stainless steel seats and discs. They last throughout the life of the valve – won't wire-draw, steam-cut or gall.

Be sure of highest efficiency and lowest maintenance. *Specify Hancock Bronze Valves!* Sizes range from ¼" through 2" in globe and angle types, with screwed ends – for all pressures up to 300 psi at 550° F.

**PHONE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR** for complete information about Hancock Bronze Valves. He is always ready to give you quick service.

***When Hancocks go in, valve costs go down***

**In Canada:** *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

1877 HANCOCK U.S.A.

# HANCOCK VALVES

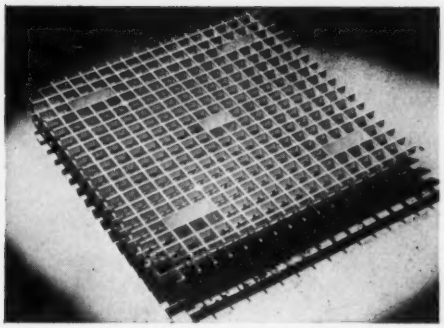
MAXWELL MANNING MM&M MOORE INC. TRADE MARK

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

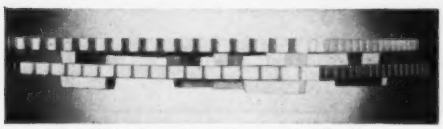
MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

# announcing

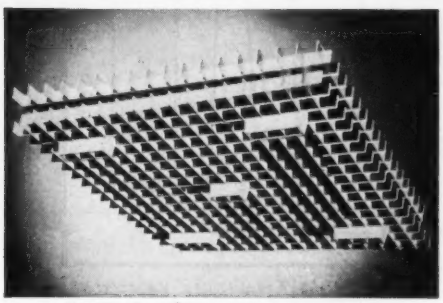
# FLUOR'S NEW poly-GRID



Overall top view as installed



Side view of packing as installed



Bottom view showing spacing supports

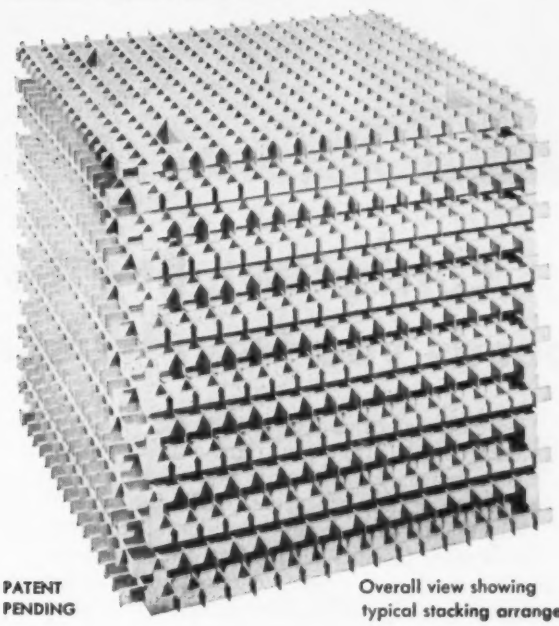
## MORE COOLING IN YOUR EXISTING TOWER

To increase the throughput of your existing counterflow induced draft cooling tower, Fluor Products Company now offers "Poly-Grid" packing.

This revolutionary packing provides greater cooling surface — greater overall heat transfer; yet construction is open, and pressure drop low.

"Poly-Grid" is available in high impact polystyrene or linear polyethylene to meet all water conditions.

Fluor "Poly-Grid" packing allows you to cool more water under existing operating conditions, or to realize extra cooling of present throughput — all at minimum capital expenditure.



PATENT PENDING

Overall view showing typical stacking arrangement

**Contact your nearest Fluor Representative for details.**

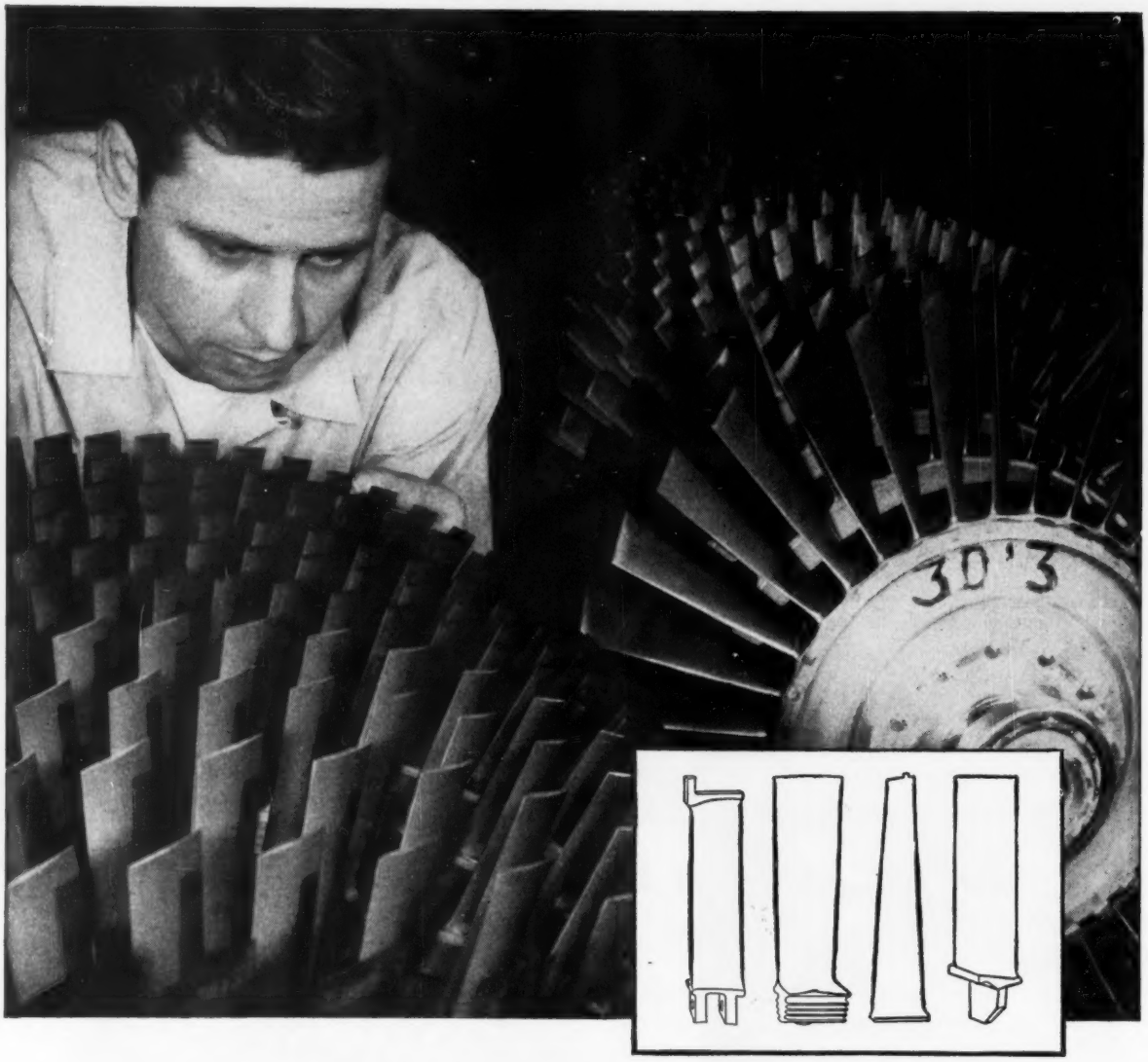
*POLY-GRID can be easily installed in any counterflow induced draft cooling tower—regardless of make or model!*

**Call him today!**

## FLUOR PRODUCTS COMPANY

A DIVISION OF THE FLUOR CORPORATION, LTD.

fp GENERAL OFFICES • WHITTIER, CALIFORNIA




# Curtiss-Wright **PROTOTYPE SERVICE** speeds you from blueprint to working model

Here's the fast, efficient and economical way to get working models from your turbine or compressor blade designs . . . whether you want a single prototype or test production quantities. Curtiss-Wright's Metals Processing Division scales down its complete facilities in a modern, geared-to-speed prototype shop . . . brings under one roof all the production steps from primary metal to finished product in any high integrity alloy.

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# unblemished safety record

For more than 40 years, Cochrane Multiport Relief Valves have served industry with a spotless record of unfailing operation.

Not once in all these years have these valves failed to open to atmosphere to protect personnel and valuable equipment against too high pressures!

Reason for this remarkable record is their unique design. Unlike ordinary relief valves, Cochrane Multiport Relief Valves automatically e-a-s-e open under excess, undesired back pressure and bleed off only the exact unusable quantity that caused the overpressure, and then gently and tightly close—without blow-down, back surge or vapor hammer!

Cochrane Multiport Relief Valves are made of various materials to satisfy maximum operating and corrosion conditions. They function equally well whether designed for saturated or superheated steam, air or gas. Their corrosion resistant, "vapor cushion" valve discs will not rust, freeze, or stick.

For complete details write for Publication 5200.

NOTE: *Cochrane Multiport Relief Valves are adaptable to check, spillover and other services.*

COCHRANE CORPORATION WATER CONDITIONING ENGINEERS SINCE 1863 PHILADELPHIA

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**Pottstown Metal Prods. Div.**—Custom built carbon steel and alloy products.

**Demineralizers • Zeolite Softeners • Hot Process Softeners • Hot Lime Zeolite Softeners • Dealkalizers • Reactors**
**Deaerators • Pressure Filters • Continuous Blowoff Systems • Condensate Return Systems • Steam Specialties**

**Why MORE and MORE people are specifying**

# J&L PRESSURE TUBING

J&L electric resistance welded pressure tubing can easily be fabricated according to your requirements. Fabrication costs are minimized.

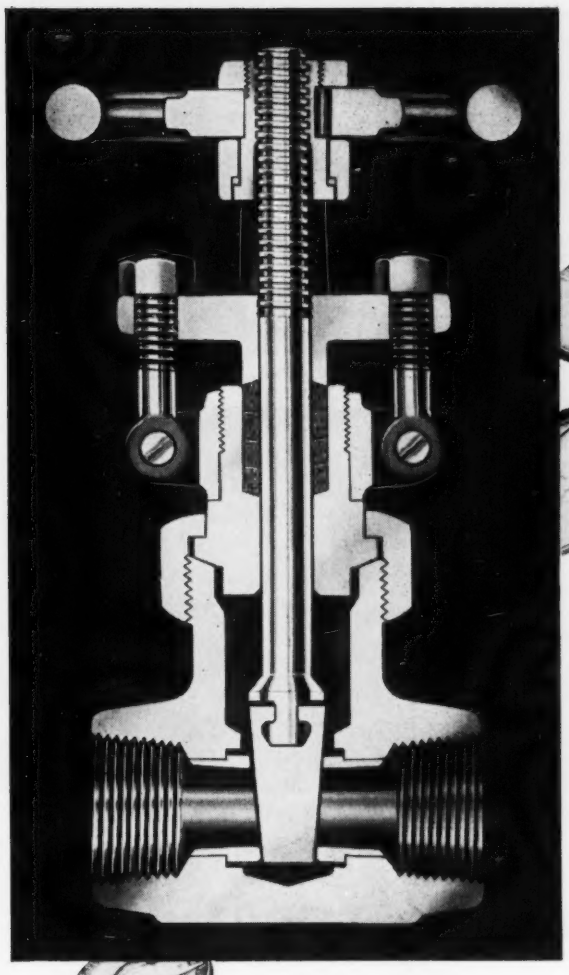
Most modern testing procedures assure maximum strength and safety standards. J&L, an integrated steelmaker, controls every step of production from iron ore to finished tubing. The J&L stencil on pressure tubing is our guarantee that every safeguard possible has been used to assure top quality for you.

Specify Jones & Laughlin pressure tubing for quick delivery, long life and maximum strength. For name of your nearest source, write to the Jones & Laughlin Steel Corporation, Dept. 511, 3 Gateway Center, Pittsburgh 30, Pennsylvania

J&L STEEL

**Jones & Laughlin**

**... a great name in steel**



## As Good as Money in Your Pocket

# CHAPMAN LIST 960

## Small Forged Steel Gate Valves!

In more cases . . . on more jobs . . . you'll find more Chapman List 960 valves at work than any other small forged steel valve. Such popularity must be deserved . . . and is. Chapman List 960 valves really have it.

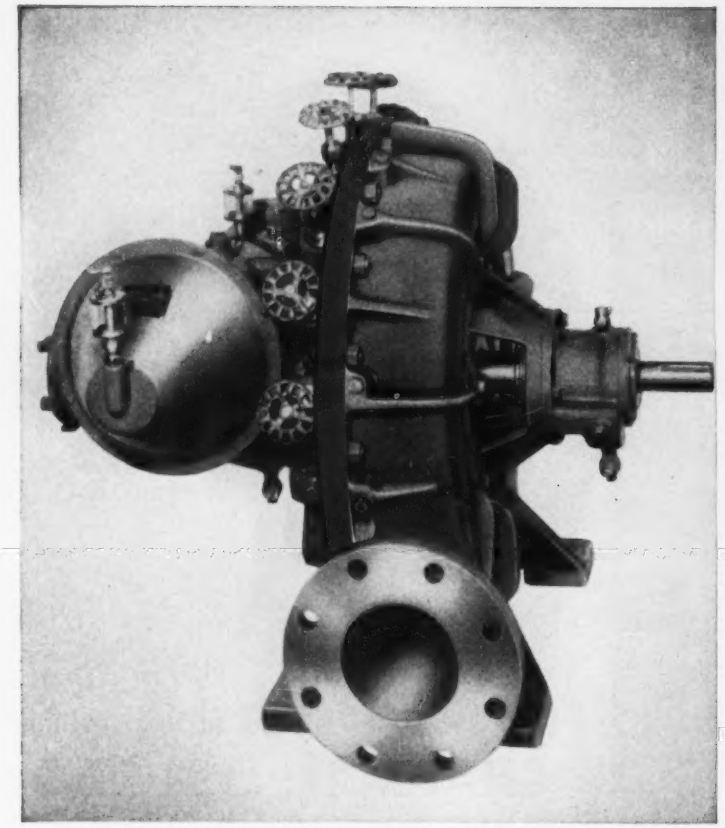
Wedge faces are super hard. They're hardened to 800 Brinell by *Chapman's exclusive Malcomizing process.* They can't gall or seize. And the seat rings are hardened stainless steel. They're hard to wear out but, when the time comes, easily replaced. There's no full pressure repacking difficulty. No exposed threads on bolted follower of the special outside screw rising stem design. No trouble makers from top to bottom.

The time and money you save on maintenance and replacements are money in your pocket. These valves stand up long and perfectly under conditions ranging from 380 psi at 1000°F. to 2000 psi at 100°F. Of course, for higher pressures you specify Chapman List 990 valves.

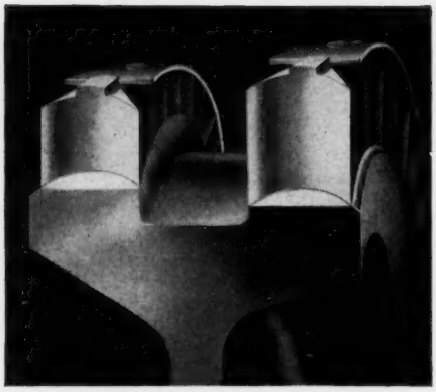
Sizes for Chapman List 960 range ¼″ to 2″. With rising stem with yoke or with rising stem with inside screw. Bonnet joint is either gasketed or ground metal to metal, as you prefer.

They're all listed, and explained in our Catalog 10. Send for it, now.

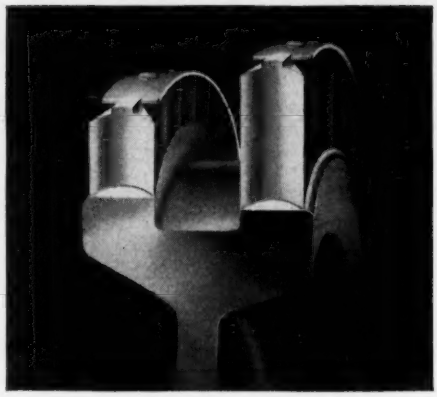
**The CHAPMAN**
**Valve Manufacturing Co.**
INDIAN ORCHARD, MASSACHUSETTS



*This is the reliable Coppus Turbine furnished with either type of wheel*



*Wide bucket "L" type wheel*



*Regular type wheel*

# *Top performance in all* COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbines.

COPPUS ENGINEERING CORPORATION
168 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

**COPPUS "BLUE RIBBON" TURBINES**

## For piping systems that can't be anchored, use ZALLEA HINGED EXPANSION JOINTS

Piping systems like the one in this 63,750 bbl/day catalytic cracking unit, one of the world's largest, at Gulf Oil Corp. Girard Point Refinery, have to be entirely self supporting. The entire cracking unit . . . reactor, regenerator and all connecting lines . . . is suspended in a huge structural steel framework, counterweighted to keep the system in balance, and fitted with Zallea Hinged Expansion Joints to provide vital flexibility plus support for the reactor.

In the 150 ft. air supply line, all thermal movement of the piping is absorbed by angular displacement in three 42" dia. Zallea Hinged Expansion Joints. Start-up air in this line is at 1000°F. Under operating conditions it is delivered at 250°F, 25 psig.

Two 50" dia. Zallea Hinged Expansion Joints in the spent catalyst line carry fluidized cracking catalyst at 950°F, 13 psig.

Since this cracking unit first went on stream, these Zallea Expansion Joints have given completely trouble-free service.

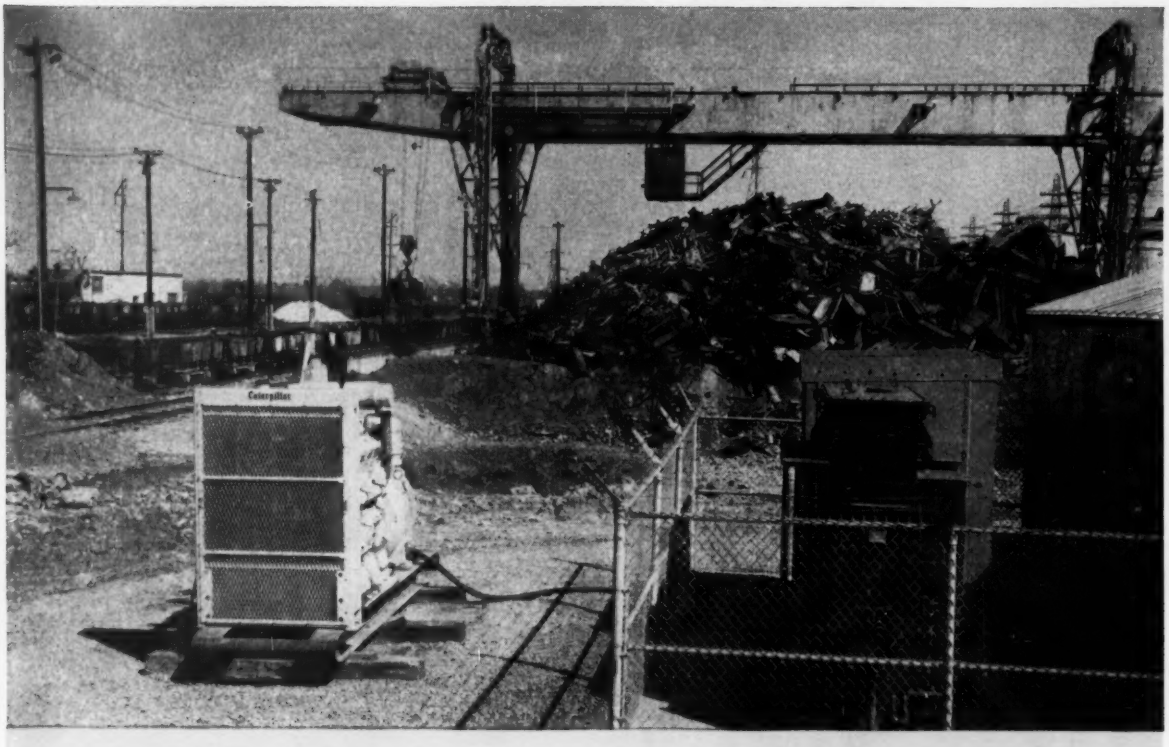
Process piping of any kind can be fully protected with one or more Zallea Expansion Joints. From the complete Zallea line you can select the expansion joint or combination of expansion joints best suited to your particular problems.

*Get the complete story* in our new 72-page manual. Write today, on your company letterhead, for your copy of Catalog 56. Zallea Brothers, 814 Locust Street, Wilmington 99, Delaware.

*Zallea expansion joints*

Zallea Brothers • Wilmington 99, Delaware

**World's largest manufacturers of expansion joints**



# HERE'S STANDBY POWER doing more than standing by

A large Texas steel mill bought this Caterpillar D375 Electric Set as standby power for 8 open hearths. But it's not sitting around waiting to go into action. Here you see it furnishing electricity for scrap yard cranes while the main feed rectifier is in repair. There are 5 gantry cranes in this yard; the hearths they feed take 225 tons per charge, charging every 8 or 9 hours.

This steel mill has 20 other CAT* Diesel Engines and Electric Sets on the job. They power locomotives, hoists and shovels, and provide emergency standby service as well.

Standardizing on Cat Diesels saves maintenance costs. It means a smaller parts inventory, since Cat-built parts are interchangeable among different models. It means fast dealer service and less down time.

The D375 in this picture is a Roots-blown electric set putting out 200 KW at 1200 RPM. Other models range from 30 to 350 KW, 60-cycle. They're available 50-cycle, too—as well as DC, which the steel mill needs for its hearth cranes.

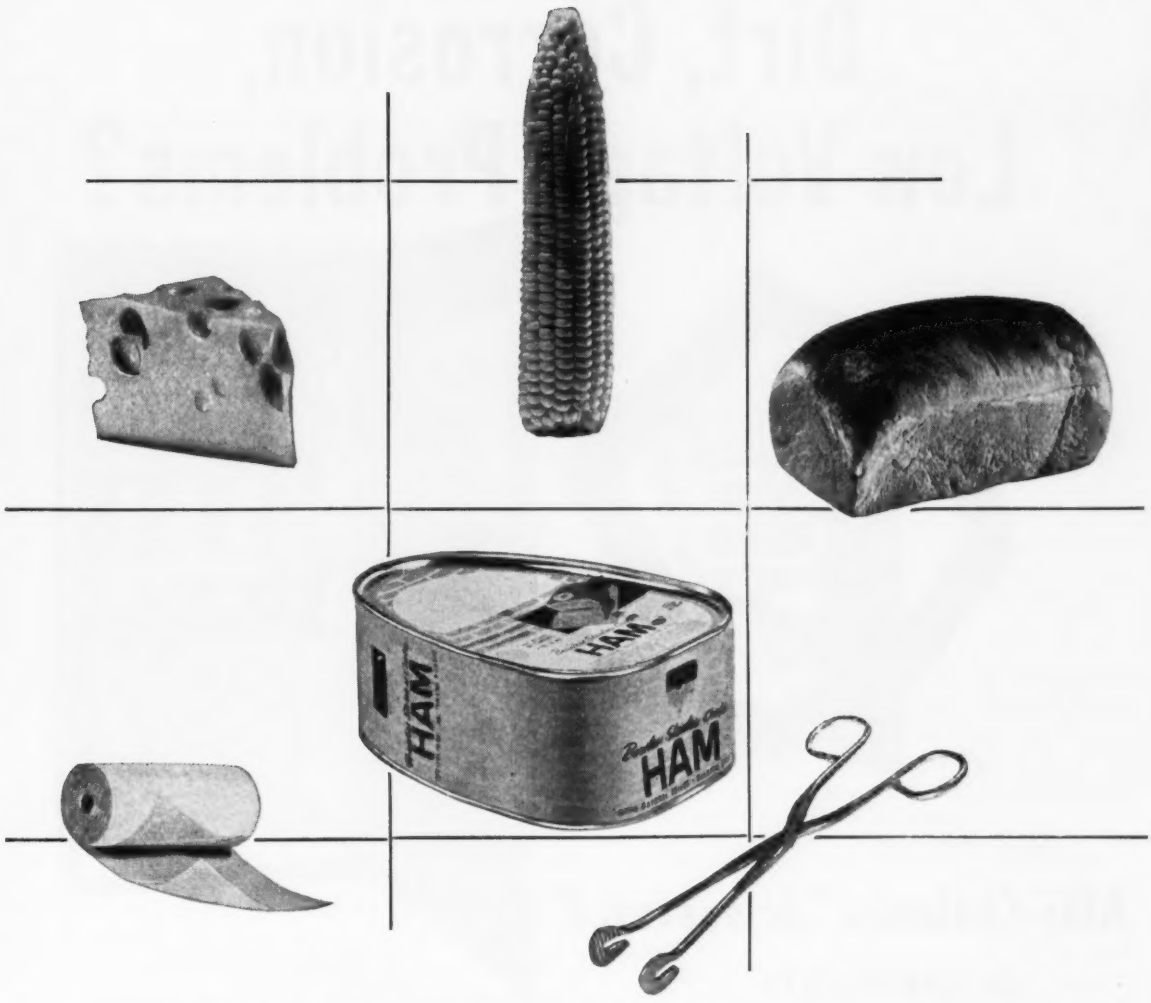
Contact your Caterpillar Dealer for complete details on his full line of dependable, tinker-free electric sets for standby or operating power. He has just the right size for your job. He offers experienced service, too—and parts you can trust. Call him soon.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

**CATERPILLAR***

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

A QUARTER CENTURY OF DIESEL LEADERSHIP




# FILMEEN-TREATED STEAM IS NON-TOXIC

**Chronic toxicity tests, conducted by a leading medical university,* prove Dearborn Filmeen is non-toxic when used in average recommended dosages, not to exceed 2.5 ppm.** This means Filmeen-treated steam may be used safely in food and meat processing plants...canneries and bakeries ...also for sterilizing surgical instruments and bandages.

The basic use of Filmeen** is to control corrosion in condensate return lines. Filmeen assures this control by forming a continuous, monomolecular film on the interior surface of the piping, protecting it against both oxygen and carbon dioxide corrosion. Filmeen provides a non-wettable barrier between the steam, or condensate, and the metal surfaces.

Filmeen is only one of many Dearborn water conditioning products scientifically developed to control specific corrosion problems. Your Dearborn Engineer can recommend the specific water conditioning program you need, including technically supervised methods and test procedures.

**Detailed information upon request.*

***FILMEEN (octadecylamine) is the trademark of a corrosion-inhibiting compound patented and produced exclusively by Dearborn Chemical Company. U. S. Pat. No. RE 23614.*

**Mail the coupon.**

Dearborn®

**...a leader in water conditioning and corrosion control for 70 years**

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PO
Chicago 54, Ill.

☐ Please have a Dearborn Engineer call.
☐ Send complete details on Dearborn Water Conditioning Program.

*Name*.....*Title*.....

*Company*.....

*Address*.....

*City*.....*State*.....

# Dirt, Corrosion, Low Voltage Problems?

Allis-Chalmers Size 6 starter, NEMA 1 enclosure.

*the answer:*

## Allis-Chalmers "dc operated" ac contactors*

Dc operators in Allis-Chalmers control assure dependable performance because they are not affected by dirt or corrosion on the armature face. Positive magnetic operation reduces contact pitting — eliminates hum and chatter—prolongs mechanical life. The operator picks up at 65% of rated voltage — holds in with as little as 35%.

### For Any Low Voltage, High Horsepower Application . . . Allis-Chalmers Modern Control — Sizes 4, 5 and 6

**Advanced Electrical Design**

*ACBO* arc-centering blowout sharply curtails arcing time, greatly prolongs contact and chute life — without blowout coils.

**Simplified Mechanical Design**

Streamlined clapper-type construction permits natural arc rise in arc chute. Sensible enclosure dimensions provide ample wiring space. Easy accessibility simplifies maintenance.

For detailed information on this complete line of modern control, call your A-C Control Distributor or A-C District Office. Or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

*Self-contained ac to dc circuit. Standard in Size 6, optional in sizes 4 and 5.

**ALLIS-CHALMERS**

A5372

ACBO is an Allis-Chalmers trademark.

LOUIS N ROWLEY, EDITOR • AUGUST 1957 • ESTABLISHED 1882 Power

# Real shortage: engineering leadership?

WHETHER or not we have a shortage of engineers—and this is still the subject of occasional debate—there's no doubt that we need to make the best possible use of the engineers we have.

I've just been reading an interesting report* on this general subject by a group of students at the Harvard Graduate School of Business Administration. To find out how to improve the productivity of engineering manpower, they conducted over 200 personal interviews with industrial executives, individual engineers, representatives of professional societies, union leaders, and university and government officials. In addition, they surveyed over 300 companies employing engineers.

To my way of thinking, the evidence they present shows we're a long way from securing maximum results from the more than 650,000 "engineers" now employed in the U.S. There are deficiencies all along the line: in organizing and planning engineering work, in hiring and training, in working conditions and equipment, in the provision of supporting personnel, and, not least, in compensation policies.

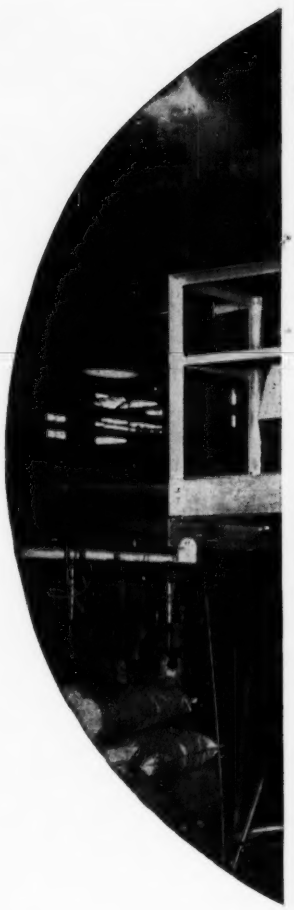
Some of the points made in the report apply with special force to large organizations employing many engineers, but most could be taken to heart by anyone responsible for the work of engineers—many or few. Of particular interest to me, and I believe to you, was the matter of leadership.

This of course is not flag-waving "leadership"—it's the too-often neglected business of seeing that the engineers reporting to you know what they're supposed to be doing, and how it fits into the total picture; that you keep in touch with their progress and problems and that you evaluate the results fairly and at regular intervals. Engineers can give their best only when they understand what is expected of them, when they know that their work is meaningful and appreciated, and when they are given an opportunity to participate in the decision-making process.

Good engineering leadership has responsibilities "up" as well as "down." As head of an engineering department, you must make sure management knows and appreciates the work your group does, and realizes what it means to the company's overall success and growth. Discharging your leadership responsibilities fully in both directions is one big step you can take toward increasing the productivity of your engineering staff—and toward securing for your department the management recognition it deserves.

*"Engineering Manpower—How to Improve Its Productivity," *a special report for management by students at the Graduate School of Business Administration, Harvard University. Published by Engineering Management Reports, PO Box 161, Cambridge 38, Mass. ($18.50).*

# "Our Turbo Air Blowers were often shutdown by motor starting currents . . . *until we changed to Fusetron Fuses*"



"As our Turbo air blowers build up speed there is a back up pressure exerted which puts an overload on the motors. Consequently, it takes longer for the motors to gain normal running speed.

"Frequently, the 100 ampere renewable fuses we were using couldn't hold these overloads—and we would have a shutdown.

"We were anxious to eliminate these down-periods, but we didn't want to sacrifice safe fuse protection on our 30 h. p., 3600 R. P. M., 220 volt, 3 phase, 60 cycle motors that power the Turbo air blowers.

"We decided to protect these motors with 100 ampere Fusetron dual-element fuses. This move proved to be the answer to our problem. Since changing to Fusetron fuses we haven't had any trouble with our Turbo air blowers being 'knocked out' on motor starting currents."

*B. D. McGaughey*
ELECTRICAL SUPERINTENDENT,
*Copperweld Steel Company, Glassport, Pa.*

## HERE'S HOW FUSETRON FUSES PROTECT AGAINST NEEDLESS BLOWS CAUSED BY HARMLESS OVERLOADS.

Fusetron dual-element fuses will hold motor-starting currents or other harmless overloads without opening because they have a tremendous time-lag.

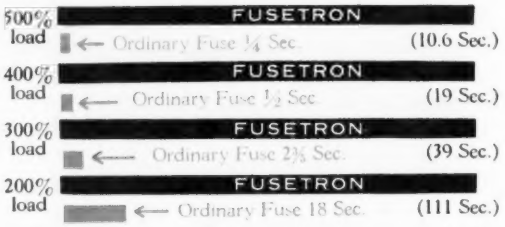
A machine may momentarily stall or be overloaded and Fusetron fuses won't open.

A motor may be started under heavy load—or all the motors on a circuit may be started at once—and Fusetron fuses won't open.

Circuits can be loaded nearer to the capacity of panelboards and switches without having Fusetron fuses open needlessly.

**Here's a comparison of time-lag between Fusetron and ordinary fuses**

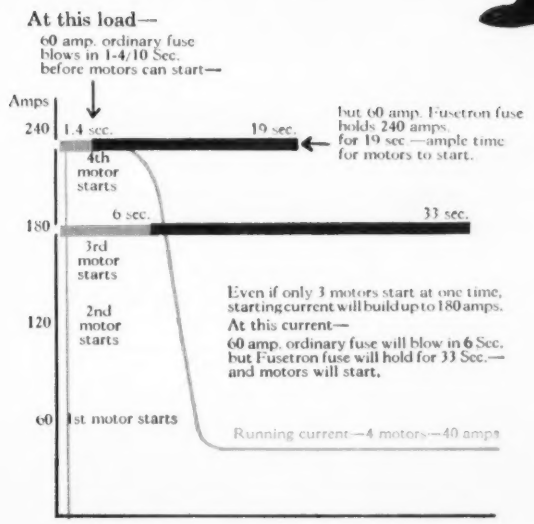
Notice that even at 500% load a Fusetron fuse will hold on for more than 10 seconds—while an ordinary fuse will open in less than ¼ second. Yet, with all this time-lag, there is no sacrifice of safety.




Comparison is based on ordinary fuses with the longest time-lag. Figures apply to 30 amp. 250 volt size. Opening time on larger sizes and on 600 volt sizes is longer.

**Here's an example of how Fusetron fuse time-lag works**

For example: take four 10 amp. motors on a circuit. 60 amp. ordinary fuses would be used to protect the circuit. BUT see what happens when four motors start at one time. The starting current of each motor is about 60 amps. so the combined starting currents would reach 240 amps.


At this load—
60 amp. ordinary fuse blows in 1-4/10 Sec. before motors can start—
Amps
240
1.4 sec.
19 sec.
but 60 amp. Fusetron fuse holds 240 amps. for 19 sec.—ample time for motors to start.
4th motor starts
6 sec.
33 sec.
180
3rd motor starts
Even if only 3 motors start at one time, starting current will build up to 180 amps.
At this current—
60 amp. ordinary fuse will blow in 6 Sec. but Fusetron fuse will hold for 33 Sec.—and motors will start.
2nd motor starts
120
60
1st motor starts
Running current—4 motors—40 amps

So with Fusetron fuses installed in Mains, Feeders and all Branch circuits—shutdowns caused by needless blowing of fuses are ENTIRELY WIPED OUT.

**Don't risk losses!** One needless shutdown . . . one lost motor . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing every ordinary fuse with Fusetron dual-element fuses. Write for bulletin FIS.

**For loads above 600 amps.— Use BUSS Hi-Cap Fuses to coordinate your electrical circuits.**

On 600 volts or less, BUSS Hi-Cap fuses have an interrupting capacity sufficient to handle any fault current regardless of system growth.

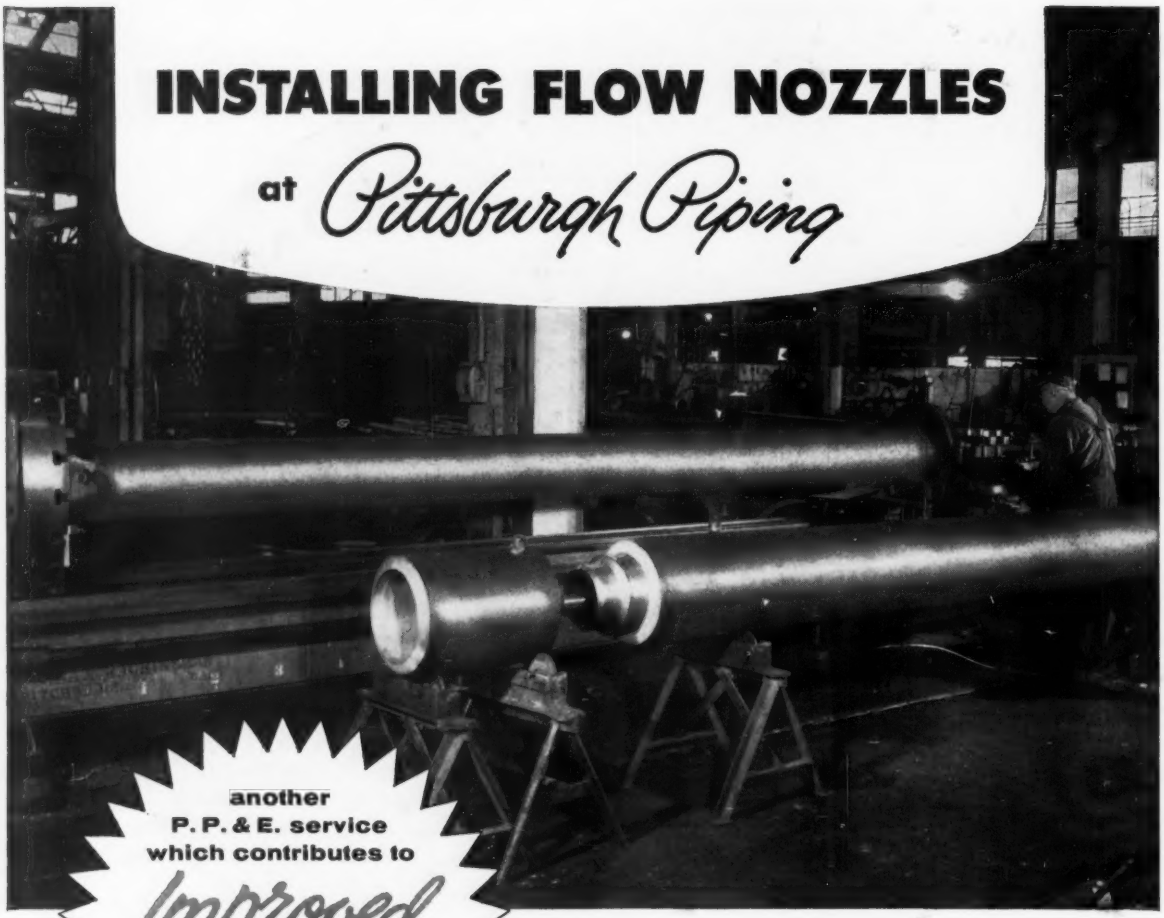
They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuits of origin. Write for bulletin HCS.

**Bussmann Mfg. Division** (McGraw-Edison Co.)
University at Jefferson, St. Louis 7, Mo.

***Play safe!*** *install Fusetron dual-element fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!*

# INSTALLING FLOW NOZZLES

at *Pittsburgh Piping*



another
P. P. & E. service
which contributes to
*Improved*
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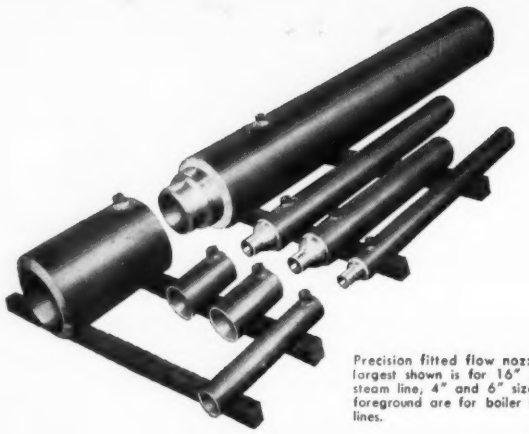
HIGH-PRESSURE
PIPING

Pittsburgh Piping's precision installation of flow nozzles in high-pressure piping is the result of extremely skillful machining, fitting, and welding by experienced craftsmen. This is another example of advanced techniques — available at Pittsburgh Piping — which provide greater safety, higher efficiency and longer life from high-pressure, high-temperature piping.



Precision fitted flow nozzles; largest shown is for 16" main steam line; 4" and 6" sizes in foreground are for boiler feed lines.

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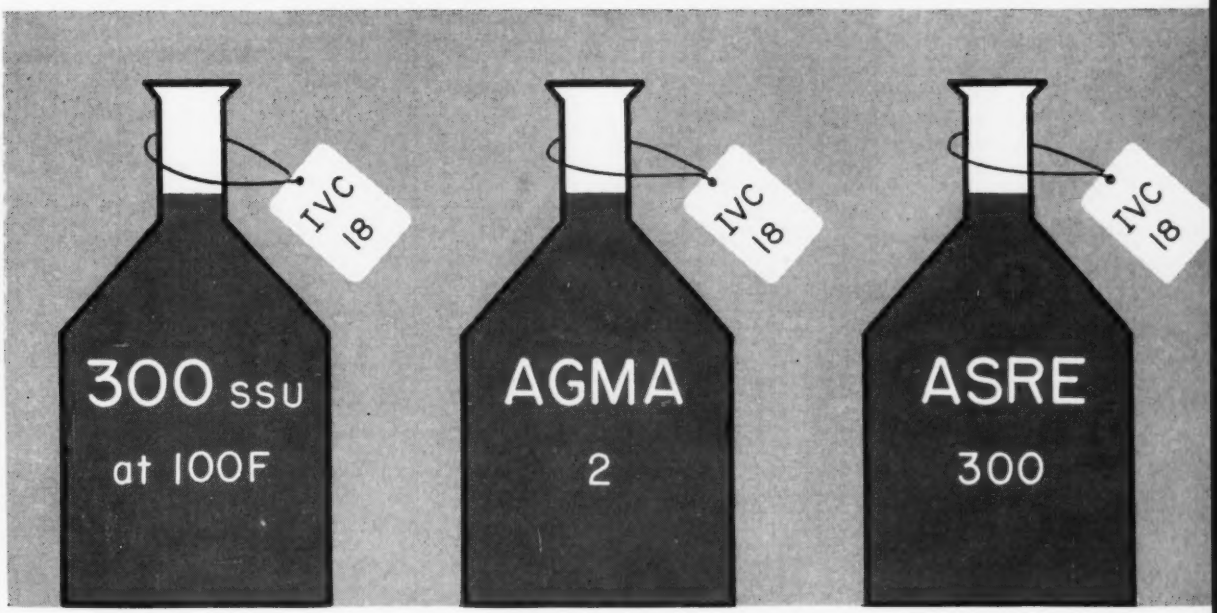


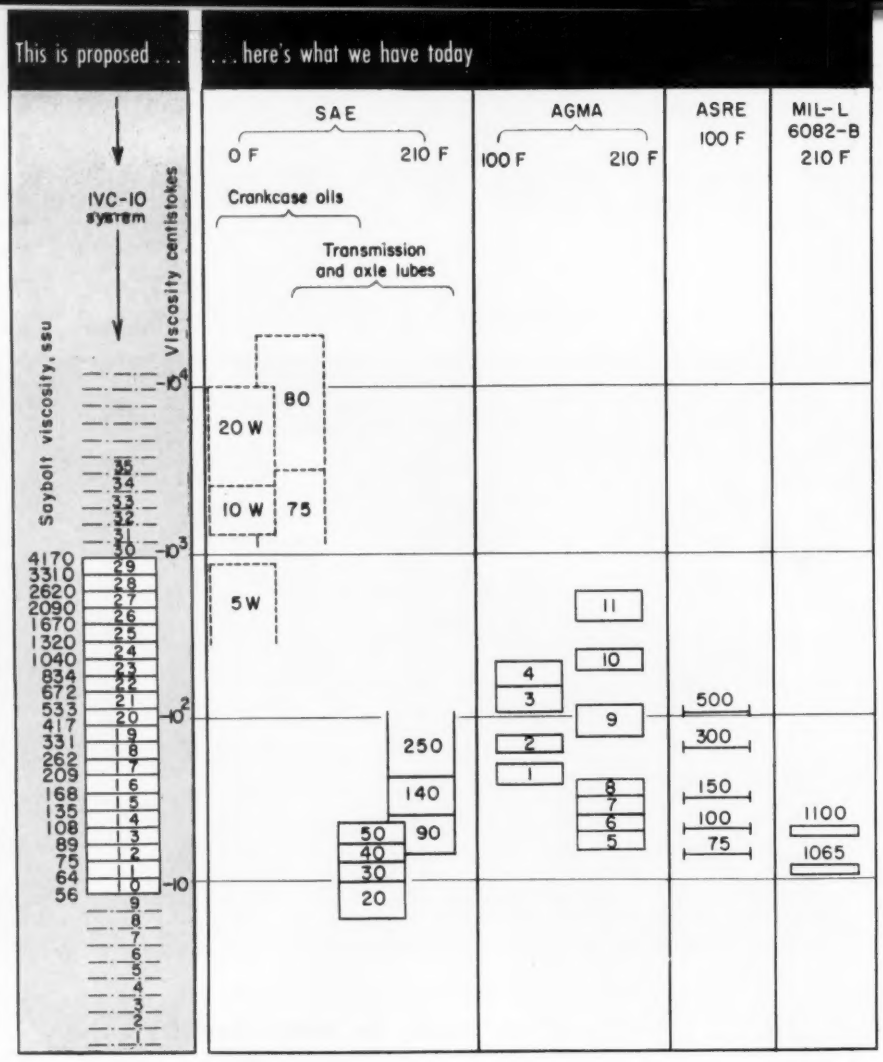

**Will lube oil classification really be simplified by . . .**

# A new common tag for like viscosities?

► LUBRICATION ENGINEERS, sitting in for general industry and oil suppliers, are weighing a new lube oil viscosity classification scheme. Without referring to oil quality, the proposed industrial viscosity classification (IVC) coding would be used in place of present AGMA, ASRE, SAE and government viscosity designations for industrial oils. The IVC two-digit numbering system paves the way for punchcard purchasing and inventory. Since viscosity doubles every third step and increases tenfold every tenth step the IVC plan appeals mathematically. Although the steel industry has successfully latched onto a similar plan, there are many problems yet to be resolved before we see such a scheme being used all across industry.

**Turn page for up-to-the-minute facts**

**Viscosity classifications at a glance**




## Though IVC system is not limited to one temperature, 100 F

► When C L Pope of Eastman Kodak stepped up to the podium during ASTM's recent Atlantic City convention, he kicked off a meeting that gave all interested parties a chance to air their views on simplified viscosity classification for industrial lubricants.

As Pope painted in background on current activity, a strong similarity could be noted to the age-old discussion about temperature classification: centigrade, Fahrenheit, Kelvin, absolute, etc. These latter classifications have been around for years and people have simply learned to live with them.

Just so, many systems of viscosity classifications have been developed over the years, *above*. But not content to rock along in this fashion, members of the American Society for Testing Materials (ASTM), American Society of Lubrication Engineers (ASLE), American Society of Mechanical Engineers (ASME), along with the American Petroleum Institute (API), have been looking into the matter of a new viscosity classification system that would be acceptable to all.

**ASTM's proposal** was summed up by John Bunting. Prior to making the formal proposals, Bunting pointed out that though viscosity of an oil is a most significant characteristic, both users and suppliers recognize that most industrial equipment can be operated, and successfully so, on oils having reasonably different viscosities. It is practically impossible to detect any operating difference in a piece of common equipment using two oils differing in viscosity by 10 ssu at 100 F. There is no full agreement as to how large a variation in viscosity can be tolerated in a specific type of equipment. So if each machinery builder recommended a unique nominal viscosity at a specific temperature, it would lead to major headaches for both users and producers.

Groups right from the federal government through the SAE, along with equipment builder associations, have fostered their own viscosity classification systems in the past. Fortunately, these earlier groups confined themselves to problems of specific equipment types and to use of only a few temperatures. Therefore, in this country, the temperatures used to specify viscosity are generally confined to 0, 100, 130, and 210 F. According to Bunting, "What we really need is a universal agreement as to viscosities of oils that should be made available for the lubrication of industrial equipment." If agreement can be reached as to what really represents a reasonable number of viscosity increments, the designer will have a starting place from which to select an oil for a given piece of equipment.

First attempt to develop an industrial viscosity classification system that could be used by all segments of industry,

## Lube oil viscosity: Terms used and what they mean

We can go back to Sir Isaac Newton (1642-1727) for the real starting point in viscosity measurement. He was the first to set up a formula for the force necessary to overcome viscous resistance of a fluid. Although this work was done in 1713, it was done so well that the relationships he established are still recognized and used as basis for viscosity measurement.

Newton used two long concentric cylinders submerged in deep water. There was little difference in the radii of the cylinders. Distance between outer surface of the inner cylinder and inner surface of the outer cylinder was the actual fluid-film thickness. Sir Issac found that the force needed to rotate one cylinder was directly proportional to speed and area, inversely proportional to film thickness.

Absolute viscosity can be measured several ways. Newton's original rig has been streamlined down to a cylinder suspended in a motor-driven cup. Another method uses the time required for a steel ball to fall through a measured height of oil. The equation in $\mu = K(D_b - D_l)t$. $D_b$ is density of ball; $D_l$ is density of liquid; $K$ is a constant peculiar to the instrument; $t$ is the measured time for a ball to pass two horizontal markings on a glass tube. For example: time for a 0.15-cm-dia ball to fall 15 cm through a 2-cm-dia tube of castor oil at 68 F is 19.4 sec. This instrument is fine for oils having viscosity equal to castor oil (about 1000 centipoises) or greater at room temperature, but for thinner oils, time of fall is too short.

Kinematic viscosity is more widely measured than absolute viscosity. It's ratio of absolute viscosity to density of oil at a given temperature. Unit of kinematic viscosity $\eta$ is the stoke ($\eta$, stokes = $\mu$, poise/density, grams per cc). The reason density must be considered is that kinematic viscometers depend on oil flow under a head of oil, a function of density.

For many years, the Saybolt Universal Viscometer was widely used in the U. S. In essence, it consisted of a cylinder, holding the oil sample, with a short small-diameter outlet tube closed by a cork stopper. At constant temperature (usually 100, 130 or 210 F), cork was pulled. Then the time necessary for 60 cc of the oil to flow into a standard flask was noted. This time in seconds was the kinematic viscosity in Saybolt Seconds Universal (ssu).

But today, more accurate capillary tube viscometers like the modified Ostwald type are used. They give kinematic viscosity in centistokes, which can be converted to ssu if desired.

## would probably be standard. VI must be stated separately, if important

got its start in September 1953. At that time, one of ASTM's committees sunk its teeth into the job.

Keep in mind that no attempt was made in any of the individual or joint studies to deal with matters of viscosity index, viscosity pressure effects, oxidation stability, corrosion tendency or any other properties of a lubricant. In brief, individual industrial groups such as the ASRE, and AGMA, who have established viscosity standards for their own interest, could adopt a national standard thereby avoiding intergroup conflicts, overlap or gaps.

Bunting further pointed out that with such a system, design engineers would have at their fingertips a recognized group of viscosity standards from which to choose. Their availability could prevent unknowing sponsorship of products having special viscosity characteristics.

In the large plant, an Industrial Viscosity Classification (IVC) system could conceivably keep the variety or number of lubricants required to a minimum. By the same token, the lubricant supplier could save the time now consumed trying to reconcile the purchaser with small and insignificant discrepancies between his products' viscosity characteristics and those proposed by the designer.

Specific proposal of ASTM is built on a continuous no-gap system where subdivisions of the over-all viscosity spectrum are based on a mathematical progression. One immediate advantage of such a setup is the ease of extending the system beyond present upper and lower limits should future needs justify extension.

Kinematic units of viscosity measurements, such as centistokes, are basis for the proposed IVC system. Yet keep in mind that even though the system is based on kinematic units, the corresponding Saybolt units could be shown as a matter of information. In the ASTM proposal, 100 F was suggested as the base identification temperature with 130 and 210 F available where the 100-deg figure was not practical. In this way, the standard ASTM viscosity index tables and charts could be used to find the true viscosity at 100 F. Further, total range of the classification system should extend from the nominal values of 2 to 1000 centistokes, corresponding to 32.6 and 4620 ssu.

Two proposals finally entertained were (1) a plan based on a spread of about 25% for each grade. Here, maximum viscosity is about 25% greater than minimum viscosity of that grade. At same time, minimum for one grade is maximum of preceding grade. This system is repetitive: by increasing three grades, nominal viscosity doubles. (2) In the alternate proposal, maximum viscosity of each grade is about 45% greater than minimum vis-

cosity of that grade. Quite naturally, this involves an appreciable reduction in grades in comparison to proposal 1. This system is also repetitive, so that by increasing two grades, nominal viscosity is approximately doubled.

**ASME comments** were summed up by Lee Ballard of Tidewater in an informal progress report without conclusions or recommendations. Ballard was the first to bring up the possible refining and marketing headaches that could result from adoption of the IVC system. He also pointed out that any classification which did not conform with current practice might well call for reformulations and specification changes, plus revisions in technical literature, instruction manuals, and recommendation charts.

There were some reservations as to whether a single classification for industrial oils would suffice for the wide range of industrial equipment needs. It was also pointed out, once again, that any such classification system, referring to both ASTM proposals, could be applied to any single reference temperature. However, preference was expressed for the ten-step proposal, described as proposal 1 above.

Ballard brought out another interesting thought: each IVC number could have limits expressed in terms of ssu at some select temperature, say 100 F. This might simplify the marketing side of the picture. It was further observed, that in any new classification system, different types of equipment and applications could make different reference temperatures necessary. This is a mighty important point. Because today's equipment has a wide range of operating temperatures, any system of viscosity classification based on the viscosity at one temperature is unrealistic. However, introducing more than one temperature for classifying oils by viscosity would introduce the viscosity index factor, which would be undesirable.

**ASLE thinking** was injected by R C Garretson of Westinghouse. Using different words, but basically the same thoughts as his predecessors, Garretson drew a parallel between the present viscosity classification schemes and the mixup that existed before this country adopted standard time. Before standard time came in, many communities and railroads in the United States had their own time system.

Speaking on lubricant quality, Garretson made it quite clear that any system proposed should be completely independent of quality. The ASLE has gone on record, through its board of directors, in favor of the ten-step IVC system. Here, viscosity increases by a fixed percentage between steps, approximately doubles every third step, increases tenfold every tenth step.

Simple two-digit numbers identify viscosity grades so that punch-card systems may be used in connection with oil buying and inventory. Lowest viscosity grade normally met in industrial applications has arbitrarily been numbered IVC-10. This is equivalent to ten centistokes, while IVC-20 would be equivalent to 100 centistokes. Further, IVC-30 would equate to $10^3$ or 1000 centistokes. This makes the numbering system easy to remember. Proposed system has, of course, no reference to quality any more than shoe sizes are an indication of shoe quality.

Garretson pointed out further that the ten-step system is already in use by the Steel Industry Committee. They have found that it operates very satisfactorily.

**API comments** on the proposal were presented by G A Round, now serving as technical consultant to the Lubrication Committee of the American Petroleum Institute's Marketing Division. Up to this point in the meeting, there was general agreement on the need for a specific classification system but no settlement on any one system.

Round, a retired engineer from Socony-Mobil, found no quarrel with the statement that either of the two proposals by ASTM represented a simple, mathematically sound, division of the kinematic viscosity scale. As such it has an appeal to the mathematical mind as does the metric system of measurement. But, Round pointed out, further, U.S. industry has been built on the illogical British measurement system and lubricated quite successfully on the basis of Saybolt viscosities.

One of Round's strong points was that the problems of designers and manufacturers of industrial equipment, and those of the vast majority of consumers and lubricants marketers, would hardly be simplified by introducing a viscosity measuring system that required translation. The problem is further complicated overseas where there is a widespread demand for viscosities in Engler numbers, in addition to the Saybolt figures. So, the educational problem that would follow adoption of a system based on kinematic viscosities, would be costly in time, effort and dollars.

Lubricants are made to meet specific design and operating temperature needs. And many properties, in addition to viscosity, must be considered. However, according to Round, the ASTM proposals consider viscosity alone and at one temperature, not viscosity index; not how the oil changes body with changes in temperature and the effect of such changes on equipment performance. Throughout his discussion, Round stressed the one-temperature phase of viscosity classification, even though the ASTM proposals do not restrict themselves to any particular temperature other than to suggest a desirable standard temperature of 100 F.

Using machinery manufacturers' recommendations, API's Round pointed out some of the problems that might crop up with a new classification system. Example: a designer requires an oil of 100 ssu at 180 F. Depending upon their viscosity indices, oils Nos. 21, 22, and 23 (using the IVC system) would meet his need. If he had a low-temperature starting problem, a high VI oil in the No. 21 range would satisfy best. On the other hand, viscosity at 180 F (of a low VI No. 21) would fall far below the 100 ssu requirement at 180 F. Likewise, a similar No. 23 oil would meet it but one of 100 VI would be far above it.

If the designer selects compromise grade No. 22, can he justify it when the supplier of the high VI No. 20 oil justly states that it meets the 180 F requirement? Round went on to other examples based on specific pieces of industrial equipment, the sum and substance being that a classification system based solely on viscosity of one temperature cannot be a scientifically accurate or understandable method of indicating the viscosities wanted at another temperature. The wider the temperature difference the more unreliable and confusing such a system becomes, according to Round.

Consumers' headaches would mount, said George Round, with the injection of a lube classification system keyed to kinematic viscosities. His reasoning is based on the obvious need for a transition period since present equipment makers' recommendations and oil marketing procedures are based on Saybolt viscosities, AGMA, ASRE schemes, etc. Further, according to Round, "For the mass of consumers . . . experience indicates they are best served by brand-name lubricants . . . (based on a) complete understanding of the requirements of their equipment by the oil marketer."

Another objection to the proposed IVC scheme, from the API side of the fence, is the need for revising instruction and repair manuals, lubrication guides, machine nameplates, etc.

Next move is up to ASTM. In summing up for the meeting, Pope said: "the ASTM Committee will now study all comments and see if a workable solution can be reached."

**Calibration tests show significant changes in the discharge coefficients**

# Effect of pipe roughness on fluid meter discharge coefficient

By **STANLEY ABRAMOVITZ**, *Continental Bearing Research Corp, New York, N. Y.*

► MAIN JOB of orifice meters in a power plant is to measure quantity of boiler feedwater or condensate accurately. Since the instrument installer often guarantees a defined flow rate, the discharge coefficient must be accurately obtained and remain constant.

**Interior roughness** of commercial steel pipe, however, introduces a factor which varies the discharge coefficient of these meters. And roughness is apt to increase with the length of time pipe is in contact with fluid.

A search of available literature reveals no actual quantitative information concerning this roughness effect. However, the ASME research report, "Fluid meters—their theory and application," recognizes its existence. The report states, ". . . in general, a higher discharge coefficient appears to be obtained with a rough surface pipe than with a smooth surface pipe of the same size. . . . quantitative conclusions cannot be drawn from such data as are now available on this factor. . . ." The report mentions relative roughness, i.e., ratio of surface roughness to pipe diameter, and indicates that observations have been made using different sizes of commercially smooth pipe.

**Another source** indicates that erroneous flow measurements result when the pipe's internal surface is in poor condition. This source states that the condition of the interior surface becomes more important as pipe size decreases or orifice diameter increases; again, a relative roughness effect.

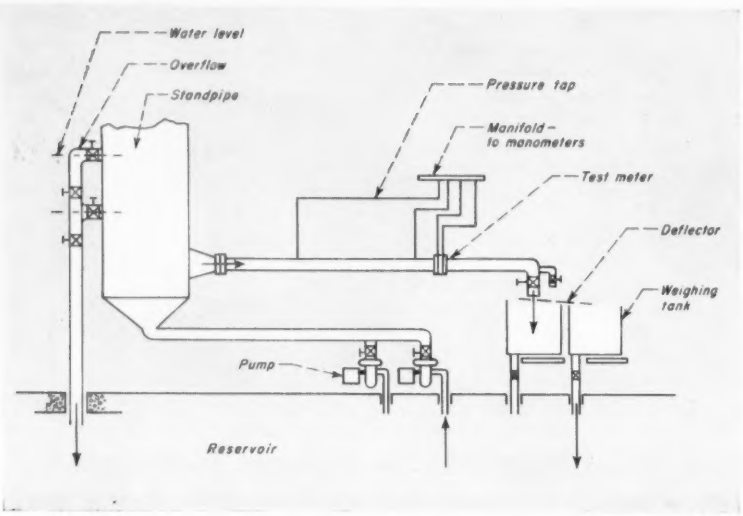
This indicated phenomenon presents an interesting research problem, which, if investigated would contribute to what we know about orifice meter behavior. Accordingly, under the critical guidance of Professor E F Stover* calibration tests have been run on orifice meters, having upstream pressure taps, with varying degrees of pipe roughness at varying distances from the meters.

A venturi tube and a sharp-edged orifice were used for the tests. Wire-mesh screen simulated pipe roughness. Three degrees of roughness were used to demonstrate the desired effect. Along with a section of pipe in the commercially smooth condition, two screen inserts were used to get approximately equal pipe friction increments. One screen was No. 18 wire, ¼-in. mesh; the other, No. 22 wire, ⅛-in. mesh. They were shaped so, when inserted in the pipe, screen surface would be as close as possible to pipe surface.

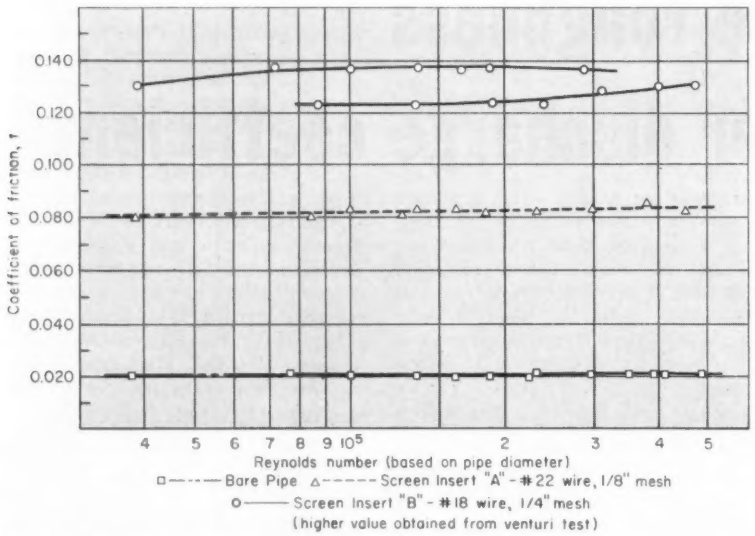
**First tests** were run with the screen's trailing edge 10 in. from pressure tap. This was done to get accurate friction values for the roughened length of pipe, since pipe's head loss pressure readings would be distorted if the screen was placed over the pipe pressure tap. Chances that the fluid velocity profile would change appreciably over the remaining 10-in. unroughened distance were slight, and so were discounted.

*Turn page*

*Professor of civil engineering; director of the Department of Civil Engineering, Towne Scientific School, University of Pennsylvania. Prof Stover obtained the meters for these tests and arranged for use of the hydraulics laboratory at the University of Pennsylvania.




1 Schematic of calibration apparatus. Unique system is completely open, permits maintaining desired head through control of feed pumps and standpipe overflow




2 Coefficient of friction for three pipe roughness values plotted against Reynolds number. Pipe roughness is simulated by using wire-mesh screen inserts

For the second group of tests, screen's trailing edge was moved to within ¾ in. of the sharp-edged orifice and the same distance from the upstream flare of the venturi. No pipe friction data was taken for this group.

**General arrangement** of test apparatus is shown in Fig. 1. System is unique in that it's completely open and a desired head can be accurately maintained. Four pumps are available to supply water to an open standpipe having overflow taps at 2½ and 5-ft levels. The taps discharge into a reservoir which, in turn, supplies the pumps' suction. Since the standpipe is large in diameter, a relatively large overflow change will produce only a small change in head. Amount of controllable overflow insures an almost constant head for a limited demand change.

The 6-in. test pipe, connected to the standpipe's base, houses test meter and has two pressure taps 80 in. apart for pipe friction determination. Pipe's discharge end has a two-valve arrangement; a small valve with an orifice plate adaptor for low fluid flow and a 6-in. gate valve for higher flows.

**Discharged water** goes into either of two 15,000-lb capacity weighing tanks accurately calibrated in 1000-lb increments. A valve and channel setup permits discharged water to be diverted into either tank so that any quantity of water can be weighed by reciprocal filling and draining of the tanks discharging into the reservoir.

Three gages: (1) differential hook gage, 0 to 0.7 ft (2) air manometer, 0.5 to 3.5 ft (3) mercury manometer, 3.0 ft and above, insure accuracy over a wide range of differential head pressures.

**Calibration tests** for each orifice and screen position were made over a range of actual throat velocities from about 4 to 25 fps. Velocity (actually, quantity) of fluid flow was varied, with the 6-in. discharge valve opening for high flows. Head in standpipe was kept at various levels depending on rate of fluid flowing.

Essential observations recorded for each test included duration of run, quantity of water, pressure differential for roughened pipe length and flowmeters, and water temperature. Because of a large reservoir and good circulation, water temperature remained constant throughout a complete calibration run, so temperatures were recorded before and after each run.

**Gage lines** were purged of air after flow was established at the beginning of test, and at periodic intervals throughout each test. Following air purging, differential manometer pulsations were of small amplitude and appeared normal. To get an accurate mean value, calculating machine was used to record pressure readings. Twenty values, taken at equal time intervals of about 3 sec, were recorded, then averaged for each test point.

To determine quantity of fluid flowing, a point was set and differential pressure values for pipe and flowmeter were recorded during time it took to fill the weighing tank (about 3 min.).

Pipe friction and meter calibration data were taken simultaneously, except when the screen was positioned close to the meter. For this condition, an average value of pipe friction was assumed, based on preceding runs.

**Pipe coefficient** of friction for the three values of roughness, plotted against Reynolds number, is shown in Fig. 2. Curve plots result from two separate runs in which screens were removed from the pipe at the end of the first run, then reinserted for second run. Curve for bare pipe is a continuous line, because roughness does not alter for a specific Reynolds number.

It's interesting to note that the intermediate screen friction curve is also continuous, despite the difficulty of re-

inserting the screen in exactly the same manner. However, runs with the rougher screen produced two distinct curves, no doubt because of wire stiffness which hampered efforts to form the screen to the pipe's surface. This discontinuity would apply only for runs where no pipe data was taken. Actually, this isn't too significant, since increments of imposed roughness are very large as compared to friction variation for the screen insert. An average coefficient of friction of 0.130 was assumed for the calibration tests in which pipe friction measurement wasn't taken.

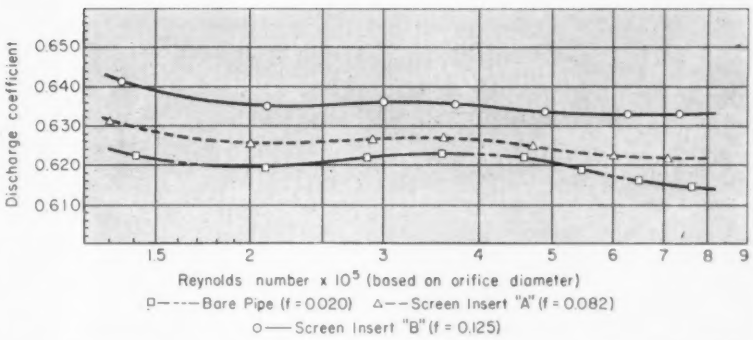
**Calibration plots** of the sharp-edged orifice are shown in Fig. 3 and 4. With the screen 10 in. from the orifice face, different degrees of roughness result in separate and distinct discharge coefficient changes; maximum being 2% as compared to the smooth pipe. With the screen ¾ in. from the orifice face, discharge coefficient shows an increase of about 6%. Also, no coefficient change is indicated above the friction value obtained with the intermediate screen.

Venturi tube calibration plots are shown in Fig. 5 and 6. In both screen positions, there's no discharge coefficient change above the intermediate screen friction value. Maximum increase, about 2%, occurs with screen located nearest pressure tap.

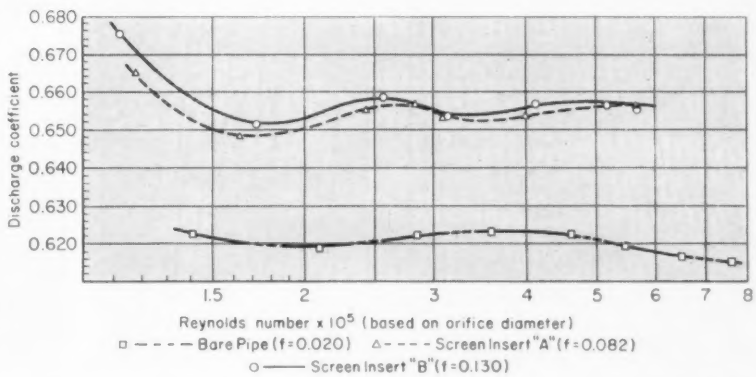
**Conclusions.** For the meters tested and conditions imposed, there's a significant increase in discharge coefficient caused by pipe roughness. Practically, the value obtained with the screen closest to the pressure tap would nearly simulate what actually occurs in the field. First tests show what might be done to reduce roughness effect. If the lower effect caused by roughness can be tolerated, possibly a relatively short, noncorrosive pipe liner could be used upstream of the meter face.

Reason for coefficient increase? One can only speculate, since no particular data was taken to determine the cause. Tests were made with meters having upstream pressure taps that would be subject to fluid impact. Reduction in boundary flow velocity and change in velocity profile caused by added surface roughness reduces the impact effect and, therefore, the upstream pressure value. If there's no change in pressure at the meter throat, differential pressure decreases. Since discharge coefficient is inversely proportion to differential pressure, the coefficient increases. Actually, the reason for this effect presents itself as a future research problem.

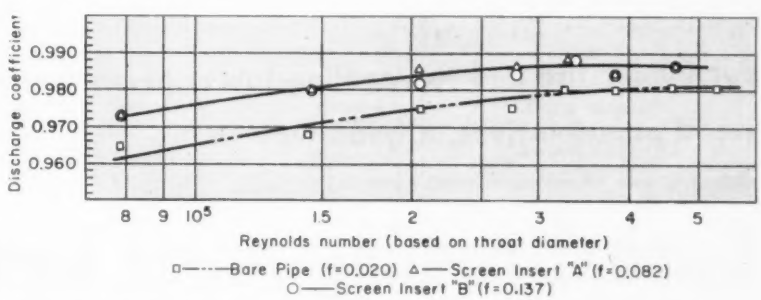
This investigation, however, shows the *quantitative* effect of pipe roughness of the discharge coefficient of two types of fluid meters.



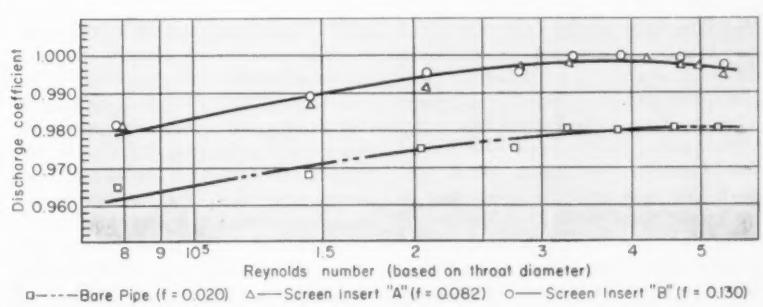

**3** Calibration plots of sharp-edged orifice, with trailing edge of wire screen 10 in. from orifice face, show maximum discharge coefficient change is about 2%



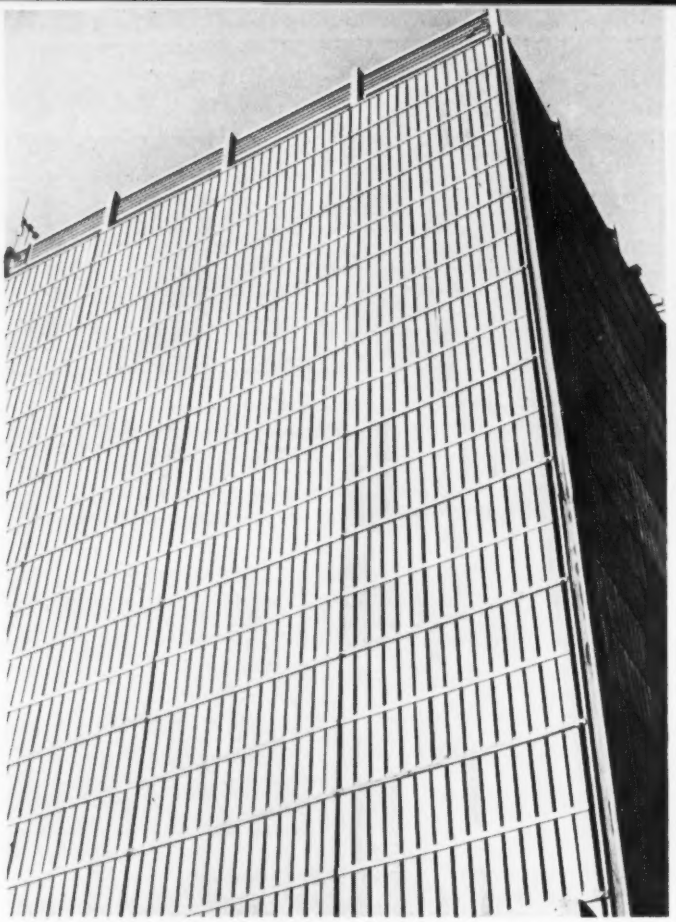

**4** Sharp-edged orifice calibration plots, with trailing edge of wire screen ¾ in. from face of the orifice, indicate discharge coefficient increase of about 6%




**5** Venturi tube plots, with trailing edge of screen 10 in. from pressure tap, show that both screen friction values produce same change in discharge coefficient

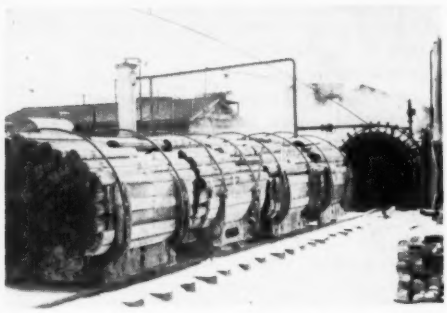



**6** Calibration plots of venturi tube, with screen ¾-in. upstream from flare, show both screens have similar effect, but the coefficient increase is about 2%



**COOLING TOWER** at Koppers Company plant has outside and internals constructed of wood, pressure treated with chromated copper arsenate salts

**PRESSURE-TREATED WOOD** has clean, dry surface. It handles as easily as untreated wood



**LUMBER** for cooling tower is loaded on tram car and run into the cylinder for pressure treatment

**For longer life and top cooling-tower performance, look into wood preservatives, a good way to . . .**

# Combat cooling-tower wood decay

► WOOD DECAY in cooling towers is and has been a serious problem for about 10 years. Formerly, natural-draft cooling towers had an expected life of about 25 years. Natural toxic materials in the redwood effectively resisted wood decay. But with the introduction of forced-draft and induced-draft towers this is no longer true.

Cooling towers are now designed for considerably stepped-up operation. Water flow rate is higher. Forced- and induced-draft designs with air-circulating fans have come into their own. So ratio of air to water inside the tower is much greater.

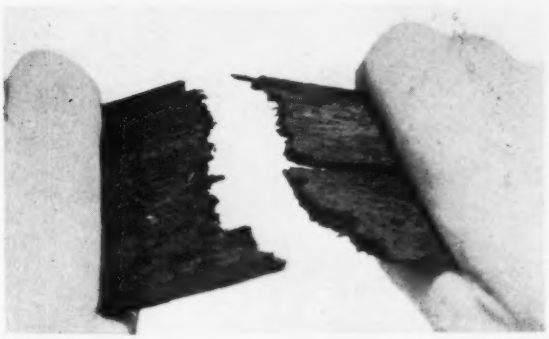
**This additional air** apparently helps create ideal decay conditions. Growth and destructive activity of many new decay causing fungi is stimulated. Natural toxic compounds in the redwood do not seem to keep these new microorganisms from destroying the wood.

In addition, the natural toxic materials in redwood are soluble. Both operating temperature and volume of wood fill have increased. These changed conditions plus higher flow rates remove toxic materials in the redwood at a faster rate. In some cases they are completely leached out in less than a year.

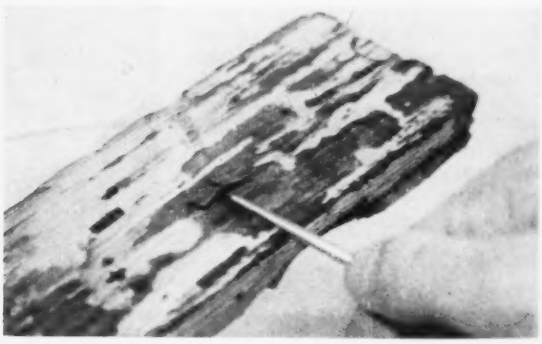
Under these conditions operating costs have soared. Rapid growth of decay organisms quickly reduces the wood strength, causes early mechanical failure and high maintenance. Replacement costs often run as high as 20% of the original tower cost for every six years of operation.

One cooling tower at a chemical company in Texas had so much decay that

## Here's what often happens to untreated wood in cooling towers

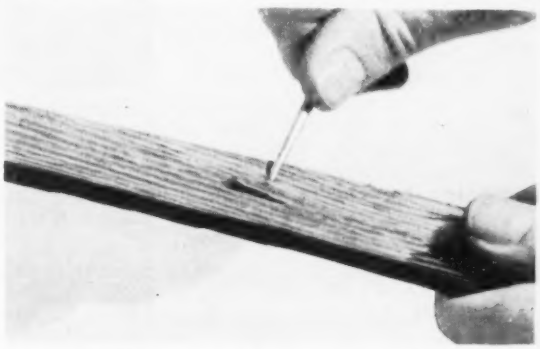


**BROKEN** fill member from a cooling tower that used untreated lumber. Failure was caused by cellulose-consuming fungus



**FUNGI,** visible on surface of this wood slat, nearly reduced the entire cooling-tower fill to a crumbling mass of lumber

**INTERNAL BREAKDOWN** caused by fungus mysellia. These are root-like cells that feed on the cellulose in wood slats



**EROSION** of untreated fill slat is caused from washing away of decayed wood by water passing down through cooling tower

the entire wood fill collapsed. Production had to be cut back 30% on one unit because of the resulting two degree increase in cooling-water temperature. Similar problems are encountered all over the country. No area can be considered immune to this attack.

It is obvious that the natural preservative compounds in lumber used for cooling-tower construction are not adequate. The wood must be fortified with toxic chemicals that will remain in the wood in high concentrations for the expected life of the tower. This is currently 25 years or longer.

Operating experience shows that pressure treatment of cooling-tower wood, with either chromated copper arsenate salts (Erdalith) or grade No. 1 creosote, will prevent decay-caused failures.

Initial cost of the treatment is low compared to the repair cost on towers constructed of untreated lumber. Actual cost comparisons show that repair costs on a six-year basis are double the amount needed to pressure treat the wood initially.

**Principles involved** in protecting cooling-tower lumber have long been practiced in many diverse fields. Railroad ties, utility poles and marine foundation piling all use creosote-treated wood. Pressure-creosoted coastal-water piling has withstood alternate wetting and drying from tidal changes plus constant battering from waves without appreciable damage for over 30 years.

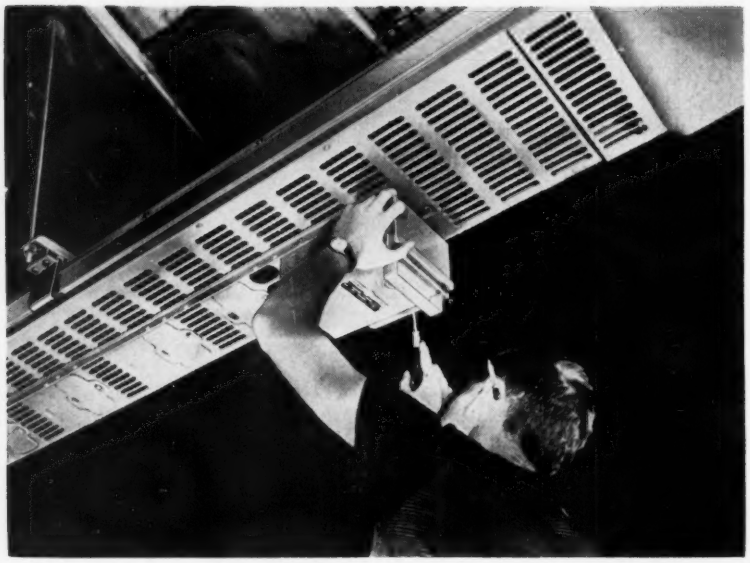
**Two wood preservatives** used today are described in the next column. Chromated copper arsenate salts (Erdalith) is a water-borne preservative developed about 30 years ago. First used in treatment of telephone poles and crossarms, its use has been extended to other products. Today it is a standard of the American Wood-Preservers' Association. Experimental tests, service life and service installations with this preservative have given excellent results. About 95% of cooling-tower lumber treatment is done with this chemical compound.

In addition to its other advantages it is noncorrosive to metal parts in the cooling system since preservative chemicals remain in the wood and do not become part (*Continued on page* 198)

### Two wood preservatives

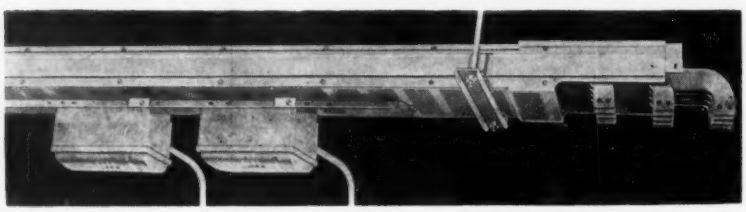
**Chromated copper arsenate salts** (Erdalith) are composed of five parts potassium dichromate, three parts copper sulfate, one part arsenic acid. They react with natural sugars in the wood to precipitate six new wood preservative compounds. These include: chromium arsenate, copper chromate, copper arsenate, chromium chromate, chromium hydroxide, and copper hydroxide. All six chemicals are insoluble in water, very toxic to cooling tower fungi. Lumber given this kind of treatment is clean to handle, does not cause dermatitis.

**Creosote** is a distillate of coal-tar produced by high-temperature carburization of bituminous coal. It is noncorrosive, permanent; has been used to preserve railroad ties, poles and piles for over 100 years. Small amounts have also been used in natural-draft cooling towers for over three decades with excellent results.



**LOW-VOLT-DROP BUSWAY,** with tapoffs at 1-ft intervals, carries 1600 amp with minimum voltage drop. Each standard 10-ft length has ten plug outlets; five on each side

**Designing for changing plant loads means keeping a close watch on voltage-regulation and current-carrying needs. So, at Chrysler's stamping plant in Twinsburg, Ohio, top planners favored . . .**



**INTERLACING** closely spaced bus bars in recurring sequence, with no adjacent bars having the same polarity, accounts for the extremely low voltage drop in this busway

# Plug-in 1600-amp busways: PTG feeds

NO. 11: BUSWAYS

► When Chrysler's engineers started planning for their new Twinsburg, Ohio stamping plant you can be sure three things were foremost in mind: (1) a top-drawer electrical system to efficiently handle some 36,000 kva in welding equipment (2) a high degree of flexibility while keeping a sharp eye on overall costs (3) a readily expandable system to meet tomorrow's load growth.

**Power scheme** at the Twinsburg plant starts with 138-kv feeders running to three 10/12.5-mva transformers. Here, primary voltage is dropped to 13.8 kv through a delta-wye hookup with secondaries grounded. All of the resistance welding, the area we are concerned with in this article, is supplied from one of the voltage-regulated 10/12.5-mva transformers. Remaining transformers supply the press motors and other loads.

Metalclad switchgear, equipped with 1200-amp breaker, takes the 13.8-kv power, channels it through 1200-amp feeder breakers. From here three conductor runs of 350-mcm cable connect to fourteen 2000-kva transformers in seven double-ended unit subs. Entire plant, as pointed out by L E Fisher of GE and R W Dailey of Chrysler at the Annual

## Here's one sound approach to circuit-breaker selectivity

A circuit-breaker selective system is probably one of the best ways to get true selectivity between busway feeder breakers and main circuit breakers. In such a setup, the main breaker is equipped with a few cycles delay; just enough to allow the feeder breaker to trip without opening main breaker. But keep this delay to an absolute minimum; if an arcing fault occurs between main and feeder breaker you want the main breaker to trip out fast.

Considering selectivity at the Twinsburg plant, first look at both busway loops operating in parallel. Here, maximum possible short-circuit current is 57,500 amp near the input ends of any busway and about 52,000 at farthermost point—the midpoint of one loop. This assumes an 800-ft loop. So, short-circuit value at any intermediate point around the loop is somewhere between these two values. For the 57,500-amp short circuit at input end, the feeder breaker with instantaneous trip device, set at 10 times normal current, will trip out.

Keep in mind, large air-circuit breakers may be used either in a selective trip system or in cascade. Selective tripping means breakers are set so breaker closest to load operates first, de-energizing only faulty portion of circuit. In this scheme all circuit breakers must have adequate interrupting ratings. In a cascade operation, circuit breakers may be used beyond their interrupting rating (POWER, Oct 1953, p 106).

# for welding loads

Welding Conference this spring, is literally covered with a variety of busways.

Light-duty 50-amp plug-in busways serve the fluorescent lighting load. Motor loads and general factory needs are handled through 400- and 600-amp plug-in with aluminum bus bars braced for a 50,000-amp short circuit. Relative newcomer in the busway family, 1600-amp low-voltage-drop plug-in type, supplies the heavy welding load.

**Heavy welding** is fed through three double-ended subs each with two 2000-kva transformers and 3000-amp main and tie breakers. Each transformer handles two runs of the 1600-amp low-voltage-drop plug-in busway. Individual runs are protected with a 1600-amp breaker. Runs are about 400 ft in length with their outer ends connected, forming, in effect, an 800-ft loop between two of the 2000-kva transformers. So the transformers are effectively paralleled on the 480-v side by runs of 1600-amp busway.

Plug-in feature on any busway permits fast connection and disconnection of machines on the production floor. Plants can be retooled and buildings revamped without major wiring changes: busway, unlike conduit and cable, can be taken down and reassembled with minimum labor, using the same parts again.

**Several types** of busway meet most demands of today's industry.

*Regular plug-in busway*, most used for branch runs, provides outlets for plugging in switching equipment about every foot. Where machines are to be swapped around, you need only unplug switch and push it into another outlet at the new machine location.

*Low-impedance busway* is the logical choice for long feeders where voltage drop must be held down and currents are heavy. Even for short runs where low-voltage drop is important, as with welder loads, low-impedance duct is a sound bet.

*Low-voltage-drop feeder busway*, a new sister to the low-impedance busway, combines high capacity with plug-in flexibility. This type was used in Chrysler's Twinsburg plant.

*Current-limiting* (C-L) busway is available where high short-circuit values must be held in check. This high-reactance busway is used from entrance stubs to main switchboard in New York's Coliseum (POWER, Mar 1956, pp 80-81).

*Weatherproof feeder busway* for outdoor runs can be either a ventilated type or gasketed steel-enclosure type. Both have weather-resistant hardware. For minimum voltage drop, weatherproof low-impedance busway is suitable.

**Double-paralleled loops** of busway at the Twinsburg plant, feeding power to the heavy welding presses, was made up of low-voltage-drop plug-in type. This busway uses the interlaced bus arrangement, similar to the standard low-voltage-drop feeder busway, photos opposite page. With four aluminum bus bars in parallel per pole, busway is capable of withstanding a 100,000-amp short circuit. The four bus bars in parallel on each pole are connected together at every joint between 10-ft sections. So the 100,000-amp short-circuit current divides among the four bus bars to the tune of about 25,000 amp per bar. This feature, plus insulating supports on 12-in. centers, explains its high short-circuit strength.

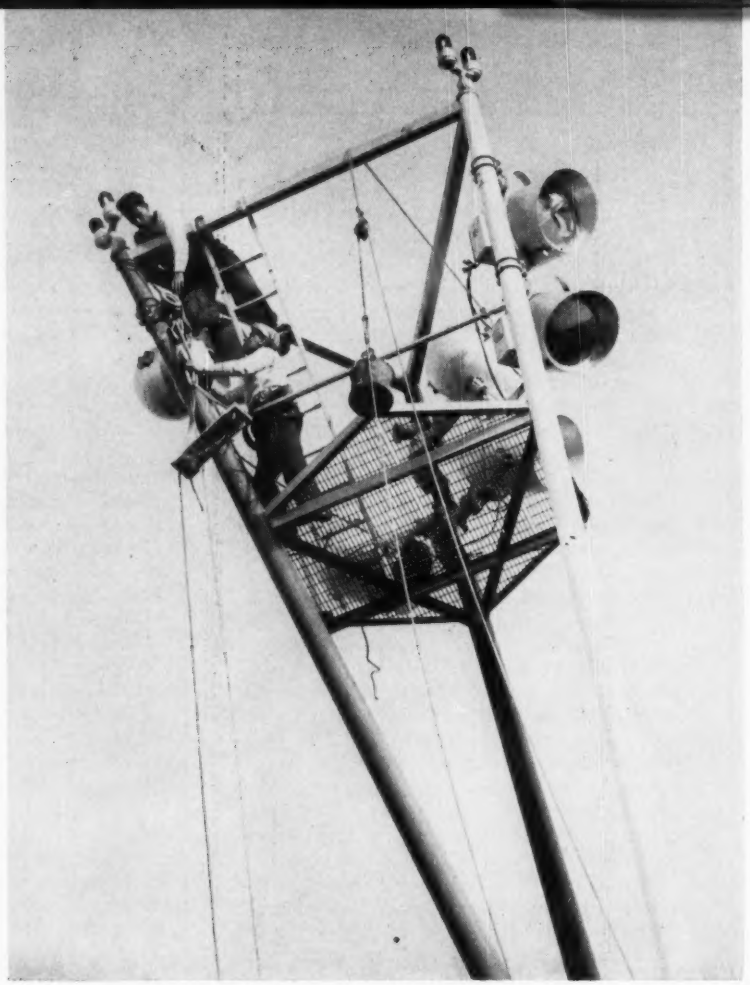
Keep in mind short-circuit forces cause the bars between insulator supports of any busway to swing back and forth. So to reduce effect of this movement on plug-in stubs, the ten plug-in openings in each section of busway are positioned directly adjacent to bus-bar supports. Tests show no damage results in either busway or plugs for a 100,000-amp short circuit on the load side of current-limiting fuses mounted in the busway plugs. Among the most important features of these busways are the extremely low values of resistance, reactance and voltage drop. Actually, voltage-drop values are roughly half that of conventional plug-in busway.

**Example:** Assuming a current of 1600-amp at a 0.70 pf on the 1600-amp plug-in busway at the Twinsburg plant on the welder distribution system: voltage drop is only 1.22 volts per 100 ft with loads distributed along the run. With the entire 1600-amp load at the end, voltage drop is 2.44 volts per 100 ft.

**Series capacitors** were considered to improve voltage regulation. Using an ac network analysis, plus some preliminary trials, Fisher and Dailey indicated all series capacitors could be grouped near the 10,000-kva main transformer. Total capacitor bank was divided into units, one unit placed in series with the 10,000-kva transformer and one in each branch circuit in series with one 2000-kva transformer. Reason: The series capacitor is unusual in that it can exactly nullify the voltage drop in a transformer or busway. And the voltage drop will be nullified for all values of load current from zero to maximum, provided all the current passing through the transformer or busway also passes through the capacitor, and vice versa.

Thus, if only one capacitor bank (*Continued on page* 186)

**THREE-LEGGED TOWER,** 75 feet high, is one of 43. Steel legs cross in center



**LAMPS ARE MOUNTED ON TOWER LEGS** and can be directed where desired. The hexagonal platform, accessible from a high-ranger truck, is for maintenance

**New York International Airport employs . . .**

# New approach to outdoor lighting

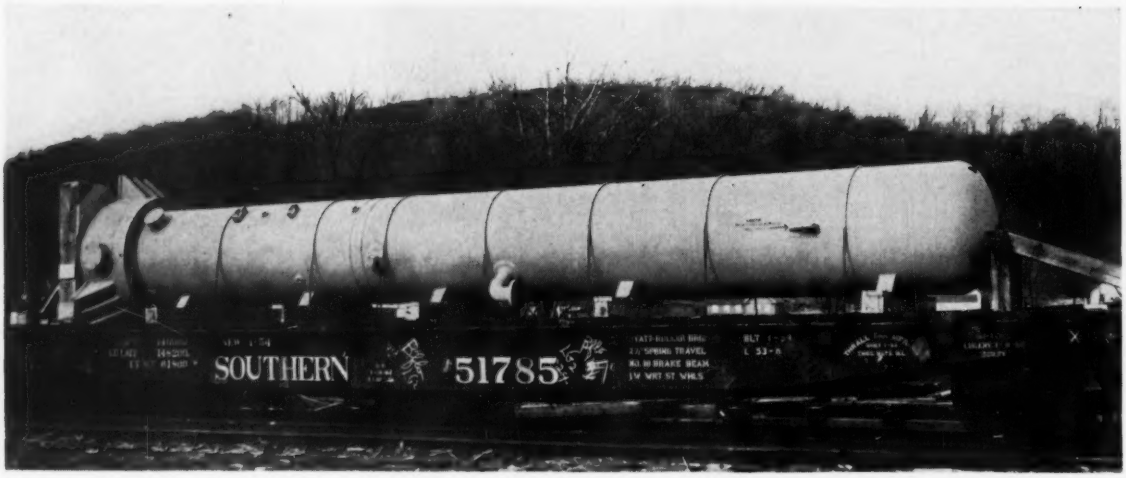
► HIGH-QUALITY FLOODLIGHTING of 250-acre plaza was problem of lighting engineers at New York International Airport's new terminal. A general blanket of light was desired, evenly distributed and with a minimum of glare. This has been achieved, together with efficiency and low maintenance, according to T M Sullivan, Chief, Aviation Planning, The Port of New York Authority. Illumination levels average 8 to 3 footcandles, and brightness ratio is less than 3½ to one. Picturesque aspects of landscaping and architecture are lighted so as to create desired effect. Plaza is seen distinctly from planes.

Important feature of new approach is high mounting of lamps. With 43 towers instead of the 275 poles estimated in conventional plans, more uniform illumination was gained. Experiments showed that tubular light source, with co-ordinated reflector, produced by the much-desired nearly rectangular light pattern. Three types of reflectors are used: completely diffuse for short-distance throw, heavily etched back and specular sides for medium throw, and lightly etched back and specular sides for long throw. Towers carry 4 to 12 luminaires. Ballasts are located in a vault in concrete base of each tower.

**MERCURY-ARC LAMP**, specially made for job, is 19-9/16 in. overall. Rated 1500 watts, 81,000 lumens, 6000 hr at five hours per start. T-9 tube is quartz

**TUBULAR LAMP** and carefully designed reflector combine to produce nearly rectangular illumination pattern. Patterns overlap to give almost uniform lighting

**WEATHERPROOF** luminaires were tested in wind tunnel with wind velocity of 125 miles an hour. Adjustable yoke mounting, shatterproof glass are features




**HEATER** is 38-ft long, has 50-in. inside diameter, with shell formed by welding two cylinders together. Total surface area is almost 13,000 sq ft. U-tube construction permits each tube to expand independently as the temperature increases

# All-welded feed heaters reach 3600 psi

**Linden Generating Station boasts high-pressure feedwater heaters fabricated completely by welding. This construction eliminates all bolted joints, reduces the possibility of leakage, yet permits head removal and access to the tube bundle without replacing any parts**

By R A BECK, *Heat Exchanger Div, The Lummus Co*

► SIX HIGH-PRESSURE all-welded feedwater heaters will be installed with No. 1 and 2 units in Public Service Electric and Gas Company's Linden Generating Station.

One of the top heaters is designed for 3600 psi, with inlet steam temperature of 678 F; the other for 3200 psi and 790-F inlet temperature. Two other heaters are designed for the same pressures, but will operate at slightly lower temperatures.

The all-welded design is in line with today's increasing emphasis on reduced maintenance for power station equipment. The trend toward higher temperatures and pressures makes it more difficult to obtain satisfactory seals using conventional bolted and gasketed constructions. Also, the current trend toward larger turbines puts a higher cost and load penalty on downtime.

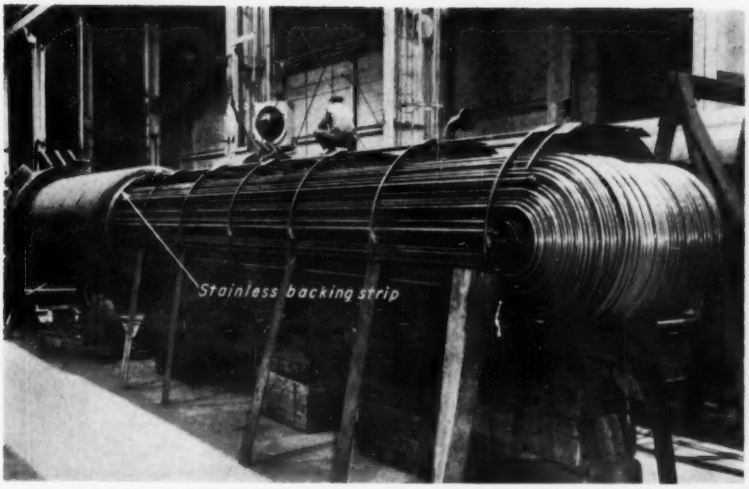
**Minimum leakage.** The heaters are designed to minimize possibility of leakage. As in most high-pressure installations, U-tube construction is used. This eliminates high-pressure joints between the tubes and floating tube sheet, and between the floating head cover and the closure. In addition, each tube can expand independently of the others as temperature increases, thus reducing the possibility of leaks caused by internal strains.

Tubes are welded, not rolled, into the tube sheet, which is an integral part of the channel forging. Extensive tests with specimens of rolled and welded joints preceded fabrication. At elevated pressures, rolled joints and tubes welded with cupro nickel rods leaked, but at 9600 psi, the tubes welded with 140-monel electrodes held firm. They were adopted for the new heaters.

Their success is attributed to the fact that both electrodes and tubes are made from nickel containing alloys. Nickel increases tube material weldability and nickel-copper alloy filler metal can be readily jointed to steel.

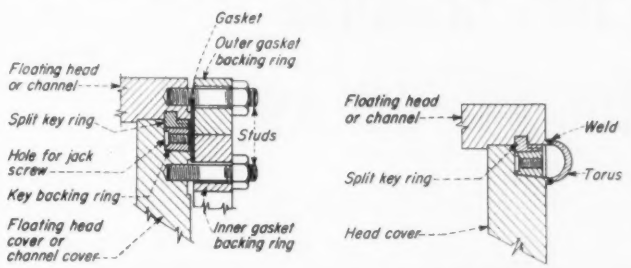
The shell is formed by welding two 50-in. diameter cylinders of 1⅛-in. thick carbon steel. Overall length is 38 ft. With conventional bolted construction, this unit would require one or two flanged joints along its length. There might be leakage at the joints because of longitudinal buckling stresses caused by temperature differences between top and bottom of the unit.

Welded construction eliminates this problem, provides a more rigid structure with less weight and lower cost.




**ACCESS TO TUBE BUNDLE** is accomplished by cutting shell at points marked by manufacturer. Stainless-steel backing strip prevents tube damage during cutting

## How conventional and welded heads compare



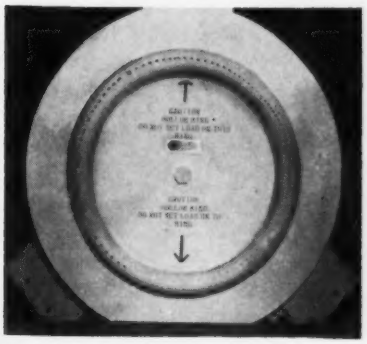

### Conventional

Gasket and two gasket rings seal pressure between channel and channel cover. For a heater the size shown in photos above, about 56 studs would be used to retain the outer ring, and about 40 studs to hold the inner ring

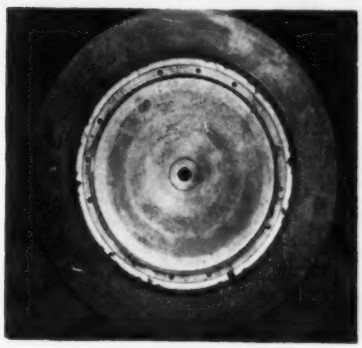
### Welded

Torus section is welded to channel and channel cover, eliminating gasket, rings and studs shown at the left. In addition, possibility of leakage is reduced. Split key ring assembly that takes the load on the cover is unchanged

## End construction details



1 End view shows welded torus ring that holds cover to channel section



2 Removing torus shows split key ring that holds the channel cover in place

3 Removing the partition covers shows tubes welded directly to tube sheet

**Head construction.** Heads of the new heaters are sealed by a steel torus section welded to channel cover and channel. In both the conventional and welded designs, force resulting from the internal pressure on the cover is absorbed by the split key ring which is in shear.

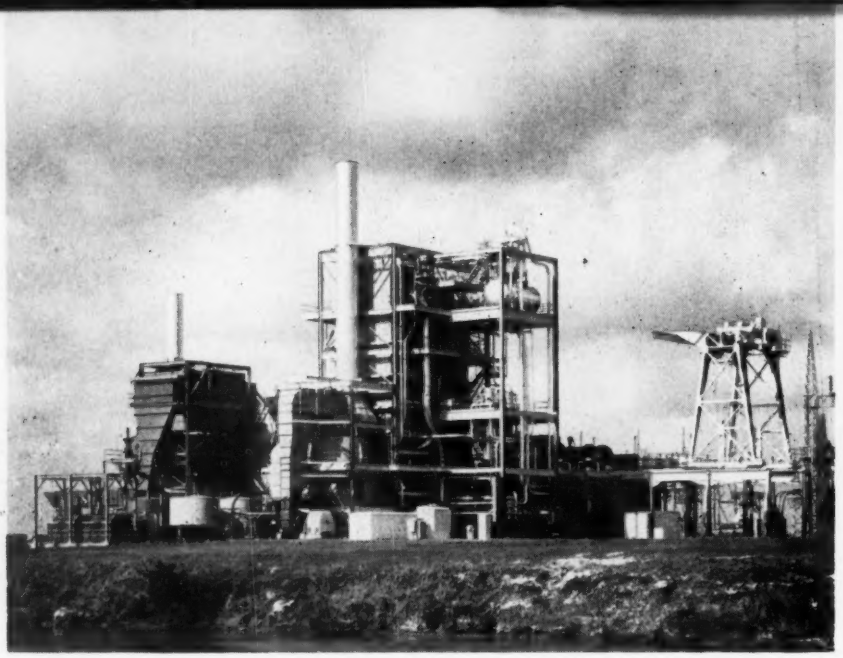
The torus section is subject to deformation; axially, as a result of clearance and tolerances on the key ring and slot; and radially, because of hoop stresses set up by radial pressure. Its section modulus was chosen to give the proper combination of elasticity and strength. Destructive tests show that the heavy channel forging will fail before the torus. Sketches, above, show the conventional bolted-head and the new welded-head constructions.

**Access for inspection.** To permit inspection, cleaning and repairs, the welded unit is designed to permit head removal and access to the tube bundle.

For the head, a special tool cuts along outer seam of the torus weld. With reasonable care, torus can be removed, repairs made, and the same torus replaced.

Access to the tube bundle requires cutting the shell. A special stainless-steel backing strip inside the shell prevents damage to the tubes during cutting. As with the head, reasonable care in cutting permits reassembly without replacing any of the parts.

**A new turbine development, plus outdoor construction and far-sighted planning, were needed to get . . .**



**TECHE POWER STATION** is on bank of Charenton Canal, Baldwin, La. New 50,000-kw Unit 2, at right, is entirely outdoors; Unit 1 has enclosed turbine-generator

# 50,000-kw reheat unit installed at Teche Station for $95 per kw

► In 1953, when Central Louisiana Electric Co's system peak load was 55,000 kw, management decided to install a 50,000-kw 1450-psi 1000/1000 F reheat unit at Teche Power Station in southern Louisiana. In service since the middle of 1956, this is the first installation using reheat where capacity is less than 60,000 kw.

Making the decision required far-sighted thinking on (1) the pickup of integrated load with Gulf Public Service Co (2) new load for both systems (3) proposed interconnections with neighboring utilities (4) future gas fuel prices and availability. Final approval provided that the installation be constructed at the lowest possible cost.

After numerous studies and preliminary estimates, management decided to make this installation entirely outdoors, even though Unit No. 1 had an enclosure for its turbine-generator.

Controls are in the existing control room and ground floor space has been provided for extending the control room when needed. Table, p 88, shows principal equipment for the new unit.

**The new boiler** is as close to the turbine as physically possible, to reduce cost of both mechanical and electrical connections. It is gas-fired, pressurized, and has intertube wall burners and a plastic weatherproof casing. The spray-type superheat temperature control is located between the high- and primary-temperature sections. Reheat temperature is controlled by varying gas flow over the secondary section of the reheater, and is accomplished by positioning the dampers below the economizers.

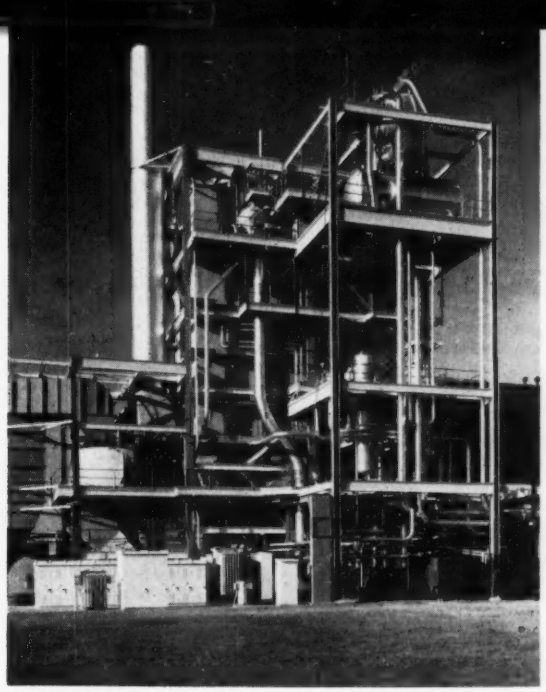
**The turbine-generator** is weatherproof, has a skintight exciter enclosure. Turbine is a new single-flow type developed to extend the economical application of reheat to 50,000 and 60,000-kw units, with steam conditions of 1450 psig, 1000/1000 F.

A two-row wheel is used for the governing stage where steam expands from 1450 psig to approximately 900 psia at 900 F. This permits using single-shell construction for the high-pressure casing and reduces the number of stages. Span is also kept within permissible limits from the standpoint of critical speed. Exhaust hood consists of a cast upper half and a fabricated lower half.

The two intercept valves are flanged to the upper half casing, consistent with practice on 60,000 to 100,000-kw reheat turbines. All of the characteristic advantages of opposed flow are retained. The single-flow reheat turbine is about 9 ft shorter than a comparable tandem-compound double-flow reheat machine. Its efficiency is poorer at the normal exhaust, 1½ in. Hg absolute; but it gives comparable performance at 2½ in. Hg backpressure. The foundation and space requirements are about the same as those for a 44,000-kw, preferred standard non-reheat unit.

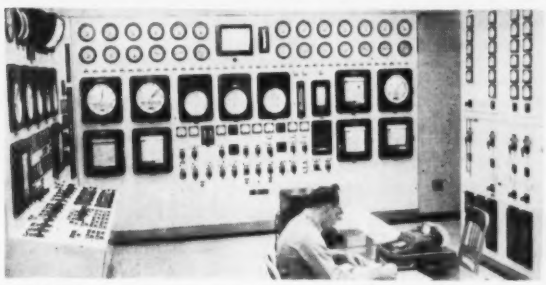
Following this pattern in design and engineering and negotiating equipment installation contracts on a firm one-price basis, kept costs low. Installation including top charges came to $95 per kw of capability, which has been established as 56,000-kw gross. Costs include primary equipment, intake structure, substation and switchgear.

**The heat rate** is 10,000 Btu per net kwhr. This is 15% lower than the company's 20,000-kw units operating at 850 psig, 900 F, and it is comparable to the



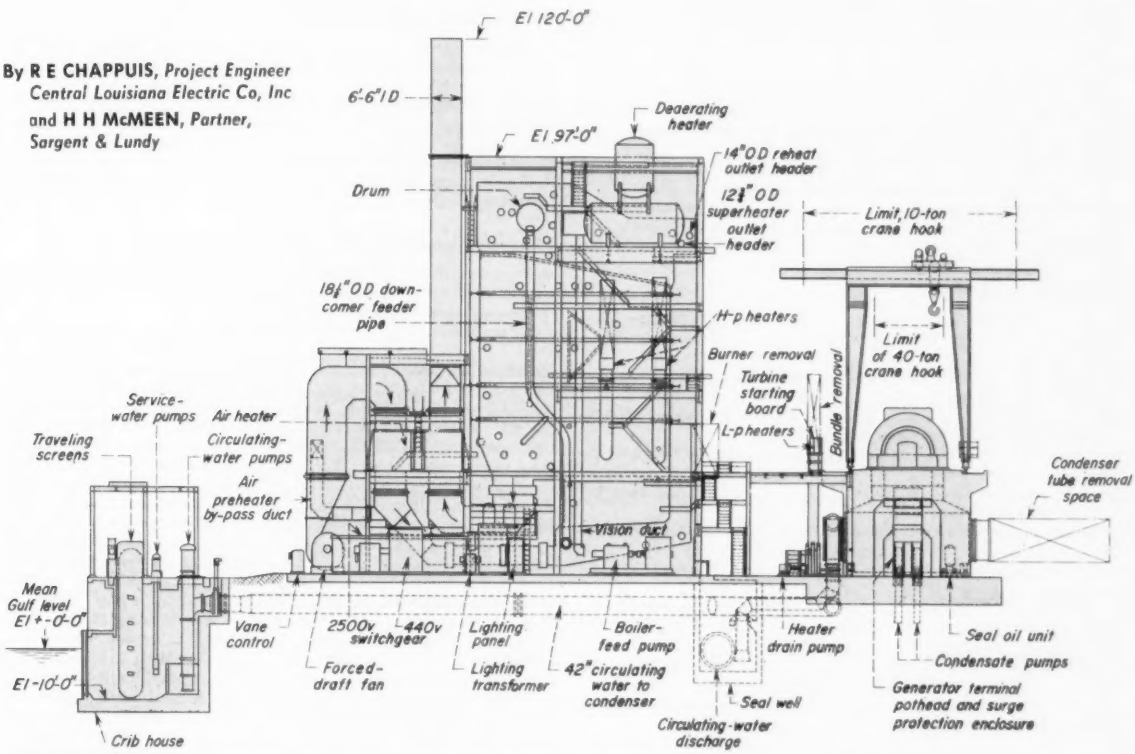
**NEW STEAM GENERATOR** produces 350,000 lb per hr, 1500 psig, 1005 F at superheater outlet. Reheat temperature is 1000 F

**TURBINE-GENERATOR** is first reheat installation with capacity less than 60,000 kw. It uses single-flow reheat design



**CONTROL ROOM** for Units 1 and 2. Additional ground floor space is available for extending control room when necessary

By **R E CHAPPUIS**, *Project Engineer*
*Central Louisiana Electric Co, Inc*
and **H H McMEEN**, *Partner,*
*Sargent & Lundy*




**CROSS SECTION** shows the general arrangement of the equipment. Boiler and turbine are as close together as practicable to reduce cost of mechanical and electrical connections. New gantry crane only serves Unit 2; crane for Unit 1 is indoors

heat rates on installations of 100,000 kw and above.

Since entering service in 1956, this unit has proved that small utility systems can compete and compare with larger systems on these points: (1) low installed cost ($95 per kw of capability) (2) low operating costs (10,000 Btu per net kwhr heat rate) (3) low operating labor (using central control) (4) low maintenance (using unit system equipment) (5) improved load factor (by interchange of power).

The installation has been so successful that the company is building a similar one at Coughlin Power Station in central Louisiana; operating date has been set for late spring, 1958.

# PRINCIPAL POWER PLANT EQUIPMENT

## Teche Power Station, Unit No. 2, Central Louisiana Electric Co, Inc

### Steam-production equipment

Steam generator, 1 — Riley Stoker Corp
350,000 lb per hr, pressurized reheat, 1650-psig drum, 1500 psig superheater outlet at 1005 F. Natural gas fired, outdoor unit with four double intertube gas burners, divided (2) sections vertically. Automatic ignition gas pilot torches. Heating surfaces, boiler, 2280; waterwall, 13,660; superheater, 16,000; reheater, 13,810 sq ft. Furnace heat release at rated capacity, 29,200 Btu per hr per cu ft. Heat recovery, economizer and air heater; superheat control, spray type. Casing designed for pressure operation using inner metal skin, insulation and outer metal casing.

Air heater, 1 — Air Preheater Corp
Ljungstrom, surface 76,600 sq ft

Forced-draft fan, 1 — American Blower Corp
127,500 cfm at 24.4 in. water; 900 rpm, motor driven; inlet vane control

### Power-generating equipment

Turbine-generator, 1 — General Electric Co
Turbine: 50,000-kw nameplate rating, 3600 rpm, 1450 psig, 1000/1000 F. Eighteen stages, five extraction points, exhaust 1½ in. Hg; steam shaft sealing; outdoor casing—governor end housed. Generator: 64,000 kva, 54,400 kw at 30 psig $H_2$ and .85 pf, 13,800 v; 4 coolers, unit may operate on 3. Exciter, 205 kw, 1778 rpm, 250 v dc, air cooled

Condenser, 1 — Ingersoll-Rand Co
Two-pass vertically divided type, 35,000 sq ft, 275,000 lb per hr design capacity; circulating water temperature 95 F; deaerating and reheating hotwell

Hotwell pumps, 2 — Ingersoll-Rand Co
Vertical, seven-stage, 415 gpm, 315 ft head, 80% efficiency, motor drive

Steam jet ejectors, 1 — Ingersoll-Rand Co
Two 2-stage elements on common inter- and after-condensers; air pilot operated pressure-reducing valve

Hogging ejector — Ingersoll-Rand Co
Two single stage, non-condensing, for quick starting

Circulating-water pumps, 2 — Ingersoll-Rand Co
Vertical mixed-flow pullout type, capacity 13,100 gpm, 31 ft head, 150-hp motors, 880 rpm

### Auxiliary equipment

Service-water pumps, 2 — Worthington Corp
1000 gpm, 50 hp, motor-driven, 1800 rpm, 2 stage, 131.5 ft net developed head, 79% efficiency

Deep well pumps — Pomona Pump Co
Installed with Unit No. 1

Boiler fill pump, 1 — Allis-Chalmers Mfg Co
150 gpm, 85 ft head, 5 hp, motor drive

Traveling screens — Chain Belt Co
Installed with Unit No. 1

Station air compressor — Ingersoll-Rand Co
Installed with Unit No. 1

Combustion control air compressor — Worthington Corp
209 cfm free air

Turbine oil transfer pump — Worthington Corp
100 gpm

Air receiver — Ingersoll-Rand Co

Turbine oil purifier — De Laval Separator Co
300 gal per hr, centrifugal

Chemical feedpumps and tanks — Hills-McCanna Co
Drum feed pump, reciprocating, 7.3 gal per hr, 2000 psig; boiler-feed pump discharge, reciprocating, 5 gal per hr, 2000 psig; phosphate and sulfite tanks, 100 gal each

Gas cleaners — Blaw-Knox Co
Installed with Unit No. 1

Water strainer — Elliott Co

Miscellaneous tanks — Daniel Jeffrey & Sons, Inc

Turbine gantry crane — Colby Steel & Mfg, Inc

### Feedwater equipment

Feedwater heaters, 4 — Alco Products, Inc
Low-pressure units, vertical U-tube, 4-pass, 250 psig, 18 BWG Arsenical Admiralty tubes; No. 1, 1430 sq ft, 250,300 lb per hr; No. 2, 1215 sq ft, 284,300 lb per hr. High-pressure units, vertical U-tube, 15 BWG 80-20 Cupro-Nickel tubes, 2300 psig, 351,200 lb per hr; No. 4, 2-pass, 1701 sq ft; No. 5, 4-pass, 1837 sq ft

Deaerator, 1 — Permutit Co
400,000 lb per hr, vertical spray heater with horizontal storage tank, internal vent condenser, 7200 gal water storage

Boiler-feed pumps, 2 — Ingersoll-Rand Co
410,000 lb per hr, 10 stage, 1675 psig differential head, 75% efficiency, 3570 rpm, 1250 hp motor. Water temperature 318 F

### Piping and valves

Main steam piping — Babcock & Wilcox Co

Reheat piping — Midwest Piping Co

Valves — Crane Co
Chapman Valve Mfg Co
Manning, Maxwell & Moore, Inc
Fisher Governor Co
Henry Pratt Co
Atwood & Morrill Co
Edward Valves, Inc
Yarnall-Waring Co

Solenoids — Automatic Switch Co

Level alarms — Magnetrol Inc

Pressure switches — Detroit Lubricator Co

Expansion joints — Zallea Brothers
United States Rubber Co

Insulation — The Aber Co
Union Asbestos & Rubber Co

### Instruments and controls

Combustion control — Bailey Meter Co
Air-operated automatic type, pneumatic control drives, 3-element feedwater control

Meters and draft gages — Bailey Meter Co

Temperature, pH, conductivity, $O_2$ recorders — Leeds & Northrup Co

Gages and thermometers — Manning, Maxwell & Moore, Inc

Drum level indicator and TV system — Yarnall-Waring Co

Feed-pump recirculation control — Bailey Meter Co

Instrument air dryer — J F Pritchard & Co

### Electrical equipment

Main and auxiliary transformers — Westinghouse Electric Corp

Reserve auxiliary transformer — Pennsylvania Transformer Co

Outdoor switching structure and equipment — Railway & Industrial Engrg Equipment Div, ITE Circuit Breaker Co

Oil circuit breakers — Westinghouse Electric Corp

Lightning arrestors — Westinghouse Electric Corp

Generator disconnect switch, outdoor — Westinghouse Electric Corp

138 KV potential devices — Westinghouse Electric Corp

Unit substations — Westinghouse Electric Corp

440-v motor control centers — Westinghouse Electric Corp

Main control board — Westinghouse Electric Corp

Meters — Westinghouse Electric Corp

Relays — Westinghouse Electric Corp
General Electric Co

Voltage regulator — General Electric Co

Annunciator — Edwards Co, Inc

Boiler-turbine gage board — Bailey Meter Co

Electrical instruments, control switches — Westinghouse Electric Corp

Turbine supervisory instruments — General Electric Co

Annunciator — Tigerman Engineering Co

Generator neutral grounding — General Electric Co

Generator surge protection — General Electric Co

Generator potential transformers — General Electric Co

Power cable — Anaconda Wire & Cable Co
General Cable Corp
Rome Cable Corp

Control cable — Kerite Co

Potheads — Anaconda Wire & Cable Co
G & W Electric Specialties

Cable pans — Rothschild Boiler & Tank Works

Motors — Elliott Co
General Electric Co
Westinghouse Electric Corp

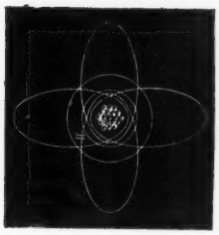
Dc feeder panel — Nelson Electric Mfg Co

Ac feeder panels — Westinghouse Electric Corp

Lighting transformer — Maloney Electric Co

Lighting cabinets — Square D Co

**Engineers** — **Sargent and Lundy**



# Nuclear notes

By B G A SKROTZKI, *Associate Editor*

**Element 102,** latest in known series of elements, has been discovered by an international team of scientists at the Nobel Institute for Physics in Stockholm, Sweden. They have proposed to name it Nobelium—it has a mass number of about 253, a half-life of 10-12 minutes and emits alpha particles. Nobelium was formed by bombarding Curium (element 96) with Carbon-13 ions in the Nobel cyclotron. Team included P R Fields, A M Friedman, Argonne National Laboratory (U.S.A.); J Milsted, A Beadle, Atomic Energy Research Establishment (United Kingdom); H A Atterling, W Forsling, L Holm, B Astrom, Nobel Institute for Physics (Sweden).

**More U-235** has been made available by U.S.A. for research and fueling nuclear power reactors here and abroad. The total now stands at 100,000 kilograms to be divided equally between domestic and foreign uses. Total value is about $1.7 billion. Foreign sales will be limited to 20% enrichment.

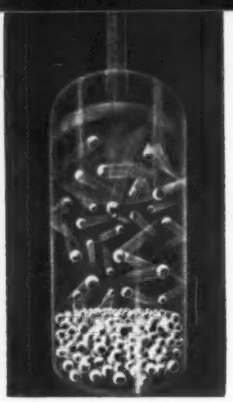
**Pebble-bed graphite reactor** has parallel tubes filled with small graphite spheres holding uranium. Fissioning uranium heats spheres and helium coolant that will generate 1450-psig 1000-F steam. Proposed reactor will produce 50 mw of heat. Alco Products, Inc and Sanderson & Porter cooperate on this one.

**Current spending** by AEC for research and development on overall reactor program (excluding production reactors) runs about $300 million yearly. Associated construction costs about $85 million yearly. About one third of the total applies to civilian uses. Private industry spends about $25 million in this area also.

**Woes of fuel-element designing**—much time may be needed to make experimental batches of fuel alloy and cladding. Then come tests of corrosion resistance and physical properties. Next comes the effort to find a good way to fabricate the element from these materials. After many months of this the element is ready for testing in a reactor under high neutron flux. It may take up to three years to complete these tests after which the elements must be cut into sections, examined and tested—all remotely in hot cells. In the meantime the reactor designers may have changed the reactor and are no longer interested in the fuel element!

**More basic knowledge** of the fundamental properties of materials must be gained to cut down the huge amount of empirical testing now done on reactor components. We have barely scratched the surface on some materials in normal environments—we urgently need more of this know-how, especially in relation to radiation effects. Unfortunately we can't compensate for lack of knowledge of materials by overdesigning a reactor—it's too expensive and won't solve the problem anyhow. By *W K Davis, director of reactor development, AEC.*

**"Nuclear Power Engineering"** by H C Schwenk and R H Shannon, 8¼x5½, 335 pp, illust, $6.50. McGraw-Hill Book Co, 330 West 42nd Street, New York 36, N. Y. Here is the single-package form of POWER's famous *Nuclear Energy Study Course* that ran for 19 installments starting in the July 1954 issue. The authors have recast and rearranged some of the material. POWER's special report *Nuclear Energy Today* has been incorporated as a series of appendices. The book features an extensive glossary of nuclear terms. Clarity and conciseness of presentation of a complex subject typifies the aim of the book as in the series. It is an excellent first introduction to nuclear physics and the application to atomic power reactors.



## THERMO REFRESHER NO. 11

**Ideal engines are jack-of-all-trades; besides producing mechanical shaft work from heat energy, they can keep an area cool by removing heat, or warm it by pumping in energy from low-temperature areas. Let's find out . . .**

# How the reversed Carnot cycle works

By B G A SKROTZKI, *Associate Editor*

► THIS MONTH we'll study the Carnot cycle some more to discover further uses and limitations it may have. We already know that thermal efficiency of the cycle depends only on temperature limits between which it works. Let's see what effects pressure, volume and piston stroke have on performance of the engine.

**Design factors.** In Fig. 1 we again use helium as the working fluid. The table shows the states at the end points of the processes and gives the work inputs and outputs and heats transferred. In *a* and *b* we have the P-V and T-S diagrams for an engine working between 500- and 700-°R temperatures. The shaded area shows the net $W$ and net $Q$ (which are equal) developed by the cycle, 40.2 Btu per lb of helium.

Thermal efficiency of the cycle equals 28.6%. Designers strive to get this factor as high as possible, but other conditions must be considered to get the best overall engine. Engine piston stroke must be manageable; in our ideal engine this appears as the volumetric displacement of the piston $V_d = V_1 - V_3$. This is the volume swept out by the piston in the cylinder. The relation of $V_d$ to $V_1$ controls maximum pressure in the cycle at $V_3$.

In practical design considerations, designers measure this effect by finding the mean effective pressure $P_m$. When $P_m$ acts for one full stroke on the piston it produces the same mechanical work as the net work of the entire cycle:

$$P_m = \frac{W}{V_d} = \frac{W}{V_1 - V_3}$$

Fig. 1*a* shows $P_m$ for the cycle and the corresponding $W$ that equals the cycle $W$ above. We can regard $P_m$ acting on the piston during the working or expansion stroke to develop the net work $W$ of the cycle. During the return or "compression" stroke of the piston the pressure is zero, so no work is done on the gas during that stroke.

We have two ratios important in describing an engine: (1) overall compression ratio and (2) overall pressure ratio. Overall compression ratio $V_r$ for the engine is the ratio of gas volumes in the cylinder at the extremes of the piston stroke, that is, $V_r = V_1/V_3$. Note that this differs from the volume ratio for a single process.

Overall pressure ratio $P_r$ is the ratio of gas pressures at the extremes of the piston stroke, that is, $P_r = P_3/P_1$. This factor gives us some idea of how heavy the engine cylinder and other parts must be made to contain the working gas. The higher the pressure, the heavier and more expensive the engine.

**Raising W.** In Fig. 1*c* and *d* we use the same engine but raise the compression ratio from 2.5 to 3.75. This boosts the pressure ratio from 3.5 to 5.25 and $W = Q$ from 40.2 to 80.4 Btu per lb gas per cycle. $W$ doubles per cycle, but thermal efficiency remains unchanged at 28.6% because the source and receiver temperatures have not been altered.

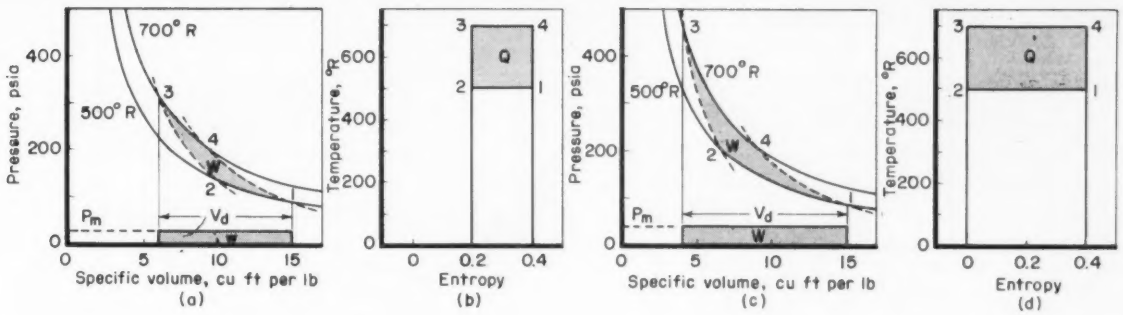
Mean effective pressure $P_m$ has risen from 24.17 to 39.55 psi; note that this pressure is neither gage nor absolute. Doubling $W$ and $Q$ has not doubled $P_m$ because $V_d$ increases with increasing $V_r$. Fig. 1*e*, *f* and *g* show how these various engine factors are related. So much for the Carnot engine as a shaft-work producer, now let's look at the reversed Carnot cycle.

**Refrigerator.** The Carnot cycle proves quite versatile in doing various jobs. Fig. 2*a* outlines the problem when we wish to cool a space below surrounding temperatures. As soon as we establish a temperature difference between two areas, heat transfers from the hotter to the colder. Here heat $Q$ leaks through the insulation from the 550-°R atmosphere into the 400-°R cold room. To maintain the lower temperature we must remove the total leakage heat $Q_c$ as soon as it enters. We can do this by using a Carnot cycle as in Fig. 2*b* but *reverse* the order of the processes.

At state *1* gas in the cylinder is in contact with the atmosphere; compressing the gas to state *2* rejects heat to the atmosphere at constant temperature of 550 °R. Total area under the process *1-2* in Fig. 2*c* measures heat rejected to atmosphere: $Q_r = Q + Q_c$.

Compressed gas is then allowed to expand adiabatically from state *2* to state *3*. Since it does work on the piston, gas temperature drops to 400°R at state *3*. The gas is then placed in contact with the cold room air at 400°R and allowed to expand at constant-$T$ to state *4*. The gas does work $W_c$ on the piston and absorbs heat $Q_c$ from the cold room during this process. From state *4* the piston then adiabatically compresses the gas, raising its temperature to 550°R at state *1*, starting point of the cycle.

Total work done by the piston in compressing the gas exceeds the work done by the gas on the piston during expansion; so the cycle loop measures the net mechanical shaft work *input* to the refrigerating engine, (usually called




**Working fluid: Helium, $c_p = 1.25$ Btu per lb, $c_v = 0.754$ Btu per lb, $k = 1.66$, $R = 386$**

| State | P, psia | V, ft³/lb | T, °R | Process, Btu per lb Q = W | W | Δ S |
|---|---|---|---|---|---|---|
| 1 | 89.5 | 15.00 | 500 | | | |
| | | | | —100.6 | | —0.201 |
| 2 | 134.0 | 10.00 | 500 | | | |
| | | | | | —150.8 | 0 |
| 3 | 313.0 | 6.00 | 700 | | | |
| | | | | 140.8 | | 0.201 |
| 4 | 208.5 | 9.00 | 700 | | | |
| | | | | | 150.8 | 0 |

**Adiabatic-process $W = c_v(T_3-T_2) = 0.754(700-500) = 150.8$ Btu per lb helium**

Net W = Net Q = 140.8-100.6 = 40.2 Btu per lb per cycle

$P_m = \frac{W}{V_1-V_3} = \frac{40.2 \times 778}{15.0-6.0} = 3475$ psf = 24.13 psi

Compression ratio, $V_r = V_1/V_3 = 15.0/6.0 = 2.5$

Pressure ratio, $P_r = P_3/P_1 = 313/89.5 = 3.5$

$e_t = W/Q_s = 40.2/140.8 = 0.286$ or 28.6%

$e_t = (T_3-T_2)/T_3 = (700-500)/700 = 0.286$

| State | P, psia | V, ft³/lb | T, °R | Process, Btu per lb Q = W | W | Δ S |
|---|---|---|---|---|---|---|
| 1 | 89.5 | 15.00 | 500 | | | |
| | | | | —201.2 | | —0.402 |
| 2 | 201.0 | 6.67 | 500 | | | |
| | | | | | —150.8 | 0 |
| 3 | 470.0 | 4.00 | 700 | | | |
| | | | | 281.6 | | 0.402 |
| 4 | 208.5 | 9.00 | 700 | | | |
| | | | | | 150.8 | 0 |

Net W = Net Q = 281.6-201.2 = 80.4 Btu per lb per cycle

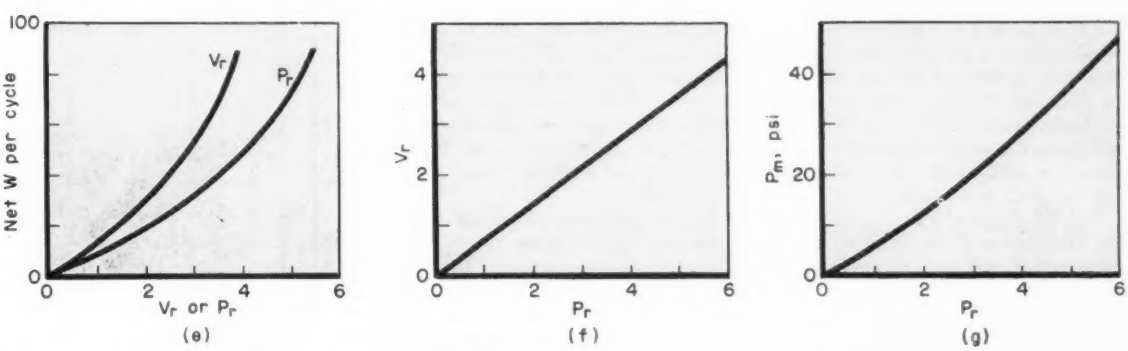
$P_m = \frac{W}{V_1-V_3} = \frac{80.4 \times 778}{15.0-4.0} = 5690$ psf = 39.49 psi

Compression ratio, $V_r = V_1/V_3 = 15.0/4.0 = 3.75$

Pressure ratio, $P_r = P_3/P_1 = 470/89.5 = 5.25$

$e_t = W/Q_s = 80.4/281.6 = 0.286$ or 28.6%

$e_t = (T_3-T_2)/T_3 = (700-500)/700 = 0.286$




**1** Increasing the stroke of a Carnot engine working between two fixed temperature limits increases net work produced per cycle, but does not affect thermal efficiency. Mean effective pressure $P_m$ depends on W and piston displacement

compressor). Overall energy flow equation for the reversed Carnot cycle is:

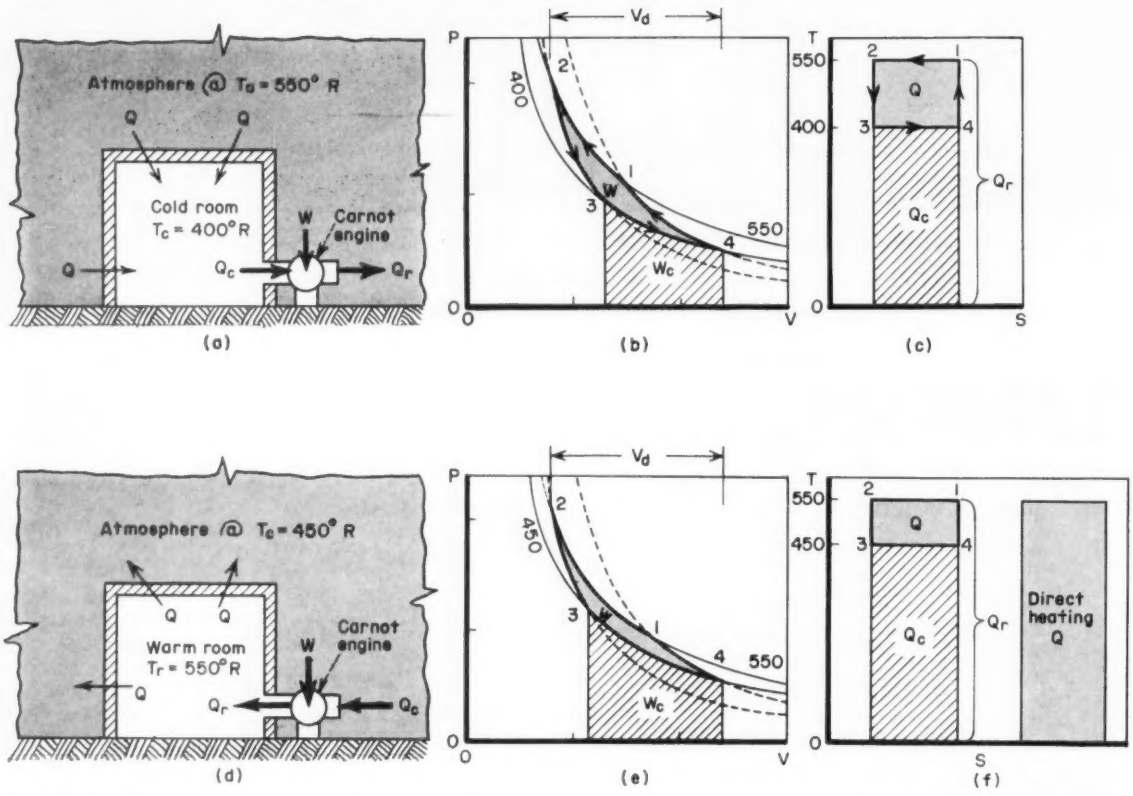
$$Q_r = Q_c + W$$

This shows that, by expending shaft work (valuable *available* energy), we can raise low-temperature energy and deliver it to a high-temperature region or receiver.

Considering this from a different viewpoint: energy naturally degrades itself from high-temperature regions to low-temperature areas by spontaneous heat transfer. We can never completely stop this energy transfer, but we can limit it by interposing suitable insulating materials between the regions. To reverse the direction of transfer we use high-grade available energy as in the reversed Carnot cycle. This is another way of stating the Second Law of Thermodynamics.

**Performance.** As in the direct Carnot cycle we are interested in developing some criterion of performance for the refrigerating application. We can use a parallel to thermal efficiency, but find we must use a different name. Most efficiencies are defined as ratio of output/input.

For the reversed Carnot cycle the useful function or output is the refrigeration or heat removed from the low-temperature region $Q_c$. Useful input is




**2** Reversed Carnot cycle, (a), (b), (c) acts as refrigerating engine to remove heat from cold room to warmer atmosphere. By hooking up reversed Carnot engine as heat pump, (d), (e), (f), it picks up "cold" energy from air to warm room

the shaft work $W$. When we divide $Q_c$ by $W$ we have a quotient usually larger than 1.0. Instead of calling this ratio an efficiency, we name it the *coefficient of performance* (*COP*). In words, its the number of units of energy removed from the cold room for each energy unit of shaft work input.

The T-S diagram, Fig. 2*c*, shows that the *COP* has sole dependence on temperature. From the simple areas we can write:

$$COP = \frac{Q_c}{W} = \frac{Q_c}{Q_r - Q_c}$$

$$= \frac{T_c(S_4 - S_3)}{T_a(S_1 - S_2) - T_c(S_4 - S_3)}$$

$$= \frac{T_c}{T_a - T_c}$$

since $S_4 - S_3 = S_1 - S_2$, according to Fig. 2*c*.

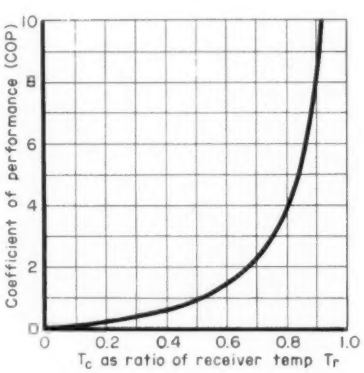
By letting $T_c$ equal various percentages of $T_a$ and assuming the latter as 1.00 we see how the *COP* varies. Fig. 4 shows the relationship. Here we see that when $T_c$ is only slightly lower than $T_a$ the *COP* is high, but as the difference grows *COP* drops rapidly. When $T_c$ is less than half of $T_a$ the *COP* is less than 1.0. In other words, the colder we wish to keep an area, the more work we must put into the refrigerating cycle per unit energy removed. A slight degree of cooling needs only a small $W$ input, giving a high *COP*.

Fig. 2*b* indicates the $V_d$ for the refrigerating cycle. Since the *COP* depends only on temperature limits, we find that raising the $V_d$ only raises the amount of heat removed per cycle with a proportionate increase in $W$. This effect parallels the one we discussed for the direct cycle.

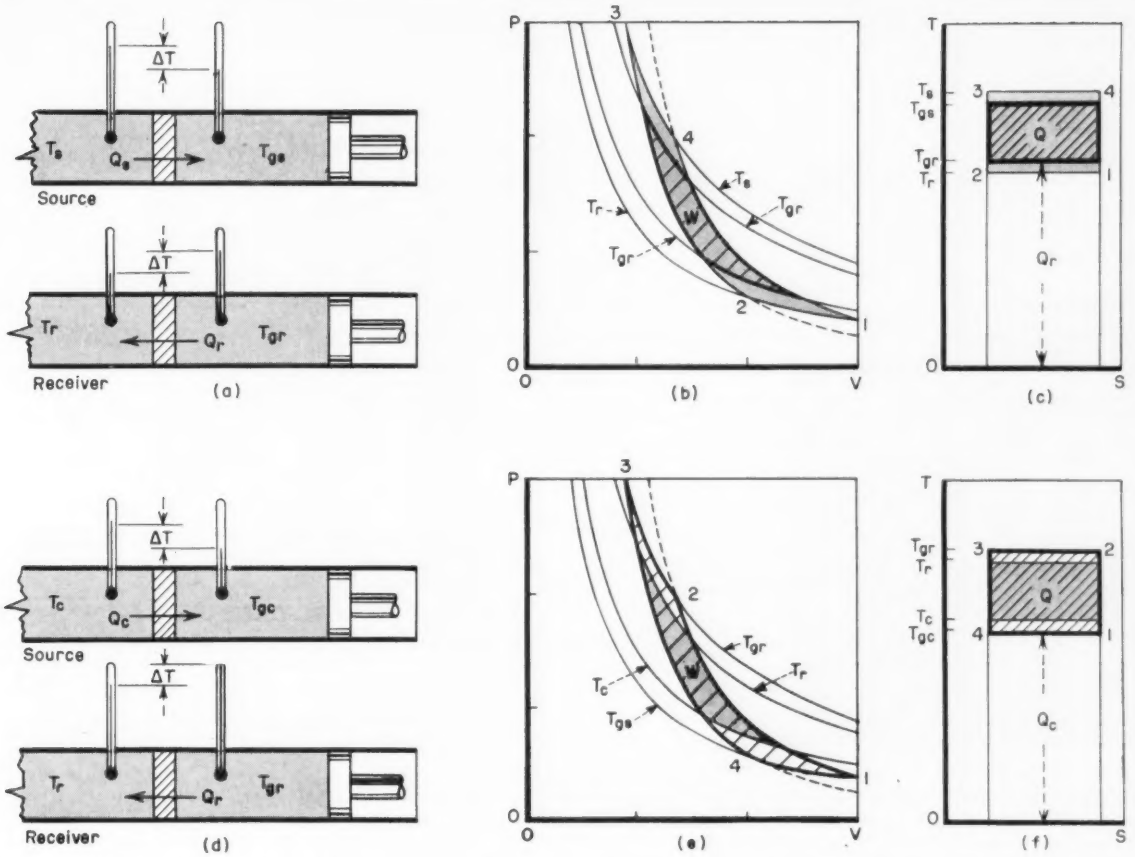
**Heat pump.** Under certain conditions the reversed Carnot cycle can be used as an efficient heating unit. Fig. 2*d* shows the controlling conditions. Here a warm room at 550°R leaks heat $Q$ to a colder atmosphere at 450°R. To maintain the warmer temperature we must have a heat input to the warm room of $Q_r$ equal to the total heat leakage.

We supply $Q_r$ by using a reversed Carnot cycle as a *heat pump*. This works as indicated in Fig. 2*e*. At state *1* we put the gas in contact with the room air and compress the gas at constant-$T$ of 550°R to state *2*; this discharges heat $Q_r$ into the room, Fig. 2*f*.

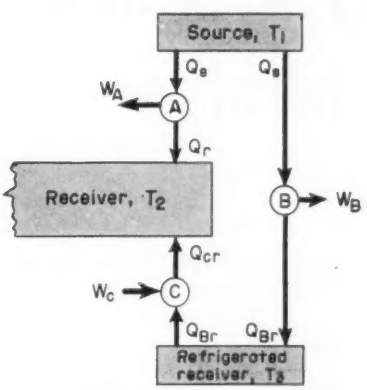
The gas then expands adiabatically to state *3* where its temperature has dropped to 450°R. At state *3* the gas is in contact with the cold atmosphere at 450°R and the gas expands at constant-$T$ to state *4*; the gas does work $W_c$ on the piston and absorbs heat $Q_c$.




**4** Coefficient of performance for reversed Carnot engine climbs fast




**3** Temperature drops needed to transfer heat reduce work output of Carnot engine, (a), (b), (c); raise the work input needed to run the reversed engine for refrigeration as in (d), (e), (f). Reducing $\Delta T$'s improves $W$ output or input




**5** Cooling a receiver for a Carnot engine doesn't raise overall efficiency

(1) $W = Q_s = Q\frac{T_s-T_r}{T_s}$

(2) $W_A = Q_s\frac{T_1-T_2}{T_1}$

(3) $W_B = Q_s\frac{T_1-T_3}{T_1}$

(4) $Q_{Br} = Q_s-W_B$

(5) $Q_{Br} = Q_s-Q_s\frac{T_1-T_3}{T_1}$

(6) $Q_{Br} = Q_s\frac{T_3}{T_1}$

(7) $COP = \frac{T_3}{T_2-T_3} = \frac{Q_{Br}}{W_C}$

(8) $Q_{Br} = W_C\frac{T_3}{T_2-T_3}$

(9) $Q_s\frac{T_3}{T_1} = W_C\frac{T_3}{T_2-T_3}$

(10) $W_C = Q_s\frac{T_3}{T_1}\times\frac{T_2-T_3}{T_3}$

(11) $W_C = Q_s\frac{T_2-T_3}{T_1}$

(12) $W_B - W_A = Q_s\frac{T_1-T_3}{T_1} - Q_s\frac{T_1-T_2}{T_1}$

(13) $W_B - W_A = Q_s\left(\frac{T_1-T_3}{T_1} - \frac{T_1-T_2}{T_1}\right)$

(14) $W_B - W_A = Q_s\frac{T_2-T_3}{T_1}$

(15) $W_B - W_A = W_C$

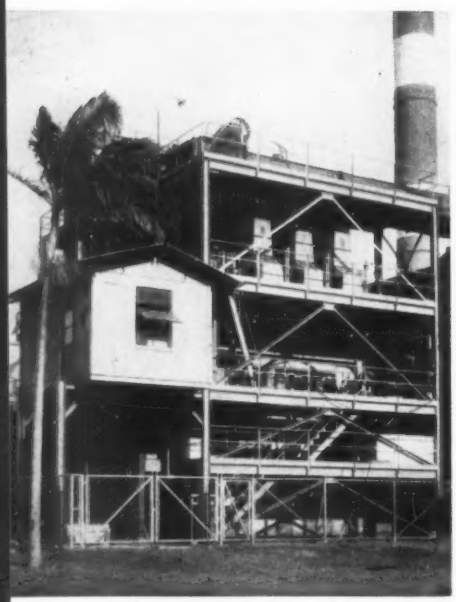
From state *4* the gas is adiabatically compressed until it reaches state *1* at 550°R, the starting point of the cycle.

Fig. *2f* shows that work $W = Q$ picks up low-temperature energy $Q_c$ to deliver a total of higher-temperature energy $Q_r$. What's the advantage of this heat pump? Suppose $Q$ is in the form of electric energy; if we used it directly in this form for resistance heating we would have to use an amount $Q$ shown in the right-hand area. But with the heat pump we need only the smaller $Q$ to deliver the same total heat energy to the room. This is a more efficient use of high-cost available energy which salvages low-temperature energy from the cold atmosphere.

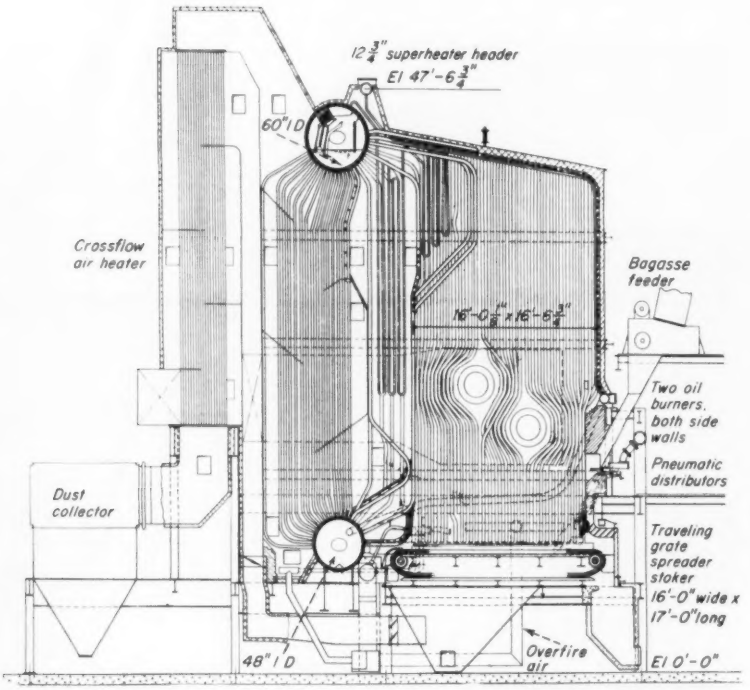
The heat pump increases its attractiveness when the temperature difference $T_r - T_c$ decreases. This follows from the improvement in *COP* and lower leakage $Q$. Of course, when cheap fuel is available, the heat pump may not offer any cost advantage. This is true in many areas today.

**Refrigerated receiver.** Now let's show why there is no advantage to refrigerating the receiver of a Carnot

(*Continued on page* 192)



**NEW H-P BOILERS** at Puunene are installed outdoors, burn bagasse and oil




**STEAM GENERATORS** run at 900 psi, 760 F; each produces 125,000 lb per hr when burning bagasse, 165,000 when burning oil. Note pneumatic distributors, stoker

# Puunene mill ups efficiency with new bagasse-fired boilers, h-p turbine

## Integrating new h-p with old l-p system helps this sugar mill meet increasing needs for process steam and power generation

By **ARNOLD A KRUSE**, *Plantation Engineer*
*Hawaiian Commercial & Sugar Co, Ltd*

► SEVERAL YEARS AGO, management recognized the need for advance planning and major improvements to our steam and electric power-generating equipment. The principal problems involved included the following:

1. To provide adequate electric energy for the increasing pump load and electrification in the sugar mills. 2. To provide additional steam for processing sugar cane juice. 3. To replace old and obsolete boiler room and power plant equipment. 4. To reduce the ever-rising operating costs.

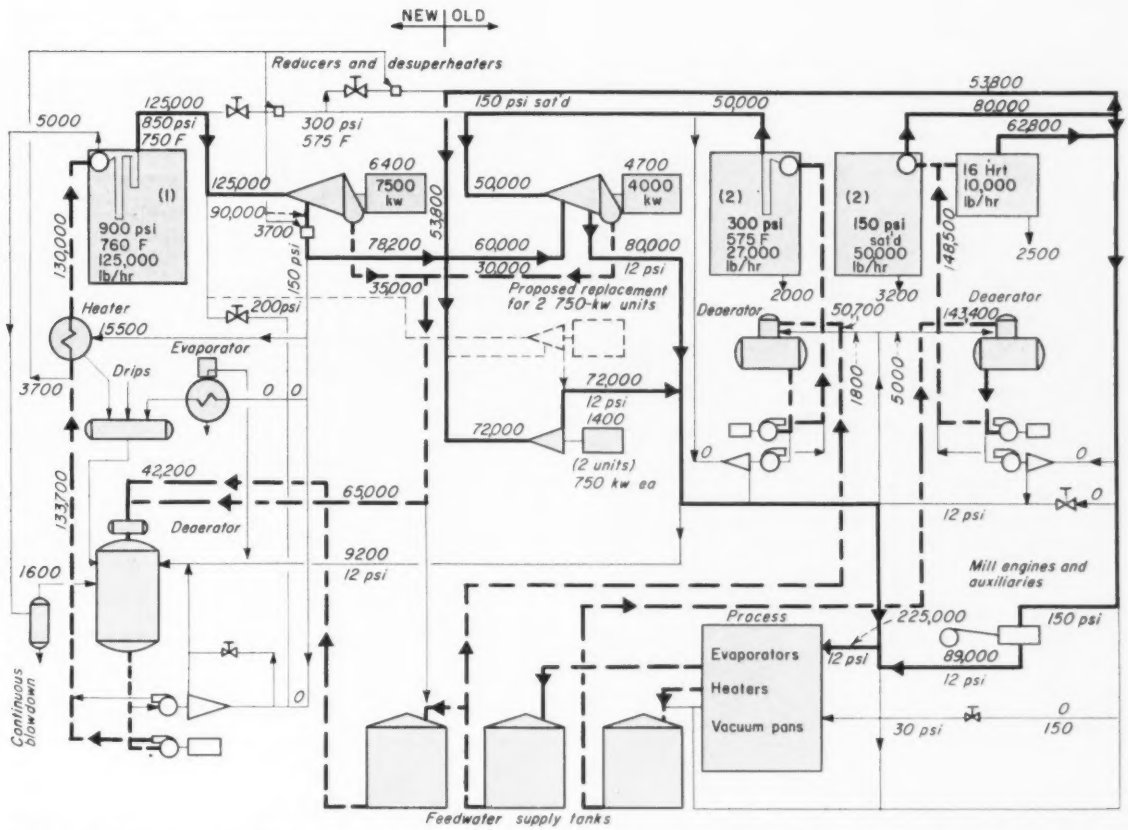
Our company has 25,100 acres of cane under cultivation, one-half of which is harvested over a period of nine months each year to produce 170,000 tons of raw sugar. The cane is processed in two mills, the Puunene mill grinding 775,000 tons of cane each season and the Paia mill grinding 495,000 tons each season.

Of the two plants, Puunene mill had the greater potential for increasing grinding rates and power production. We selected this plant for expansion and modernization. First step was to survey our steam and power needs, with the engineering and installation of necessary equipment to follow over a period of several years.

**Steam requirements.** Milling and processing require large quantities of steam, in this case at 150 psi, saturated, for the mill engines, and at 12 psi for heaters, evaporators and vacuum pans. Steam requirements are as follows:

| *Tons cane per hr on 24-hr basis* | *Lb steam per hr* | |
|---|---|---|
| | *150 psi* | *12 psi* |
| 160 | 76,000 | 185,000 |
| 180 | 82,000 | 205,000 |
| 200 | 89,000 | 225,000 |
| 220 | 96,000 | 245,000 |

These figures are for sugar mill operations only, and do not include requirements for boiler-feed pumps, feedwater




**STEAM FLOW** before installation of second 125,000-lb-per-hr boiler. This now replaces all hrt boilers, permits better use of new high-pressure turbine. Heavy solid and dotted lines indicate principal steam and water flows through the mill

heating and power generation. Steam demand fluctuates up to 20% or more of the average load, as vacuum pans are put on and taken off the line.

**Power requirements** are usually high on this plantation because of the large irrigation load. Total pump capacity, including booster units is 380 mgd. Load growth by major uses, estimated to 1960, is:

| | *kw* | | |
|---|---|---|---|
| Date | 1948 | 1954 | 1960 |
| Irrigation pumps | 9400 | 12,100 | 13,000 |
| Sugar mills and boiler auxiliary | 3900 | 5,200 | 6,800 |
| Misc industrial | 1700 | 1,700 | 2,000 |
| Total, kw | 15,000 | 19,000 | 21,800 |

Normally the pumping load is uniform 24 hours a day. But demand may vary from nil to maximum depending on rainfall and on the amount of surface water delivered by the East Maui Irrigation Company. The fluctuations are seasonal, and changes occur over a period of several days.

The sugar mill load, including boiler auxiliaries, is relatively constant; the minor miscellaneous industrial load varies only with the number of shop working hours, etc.

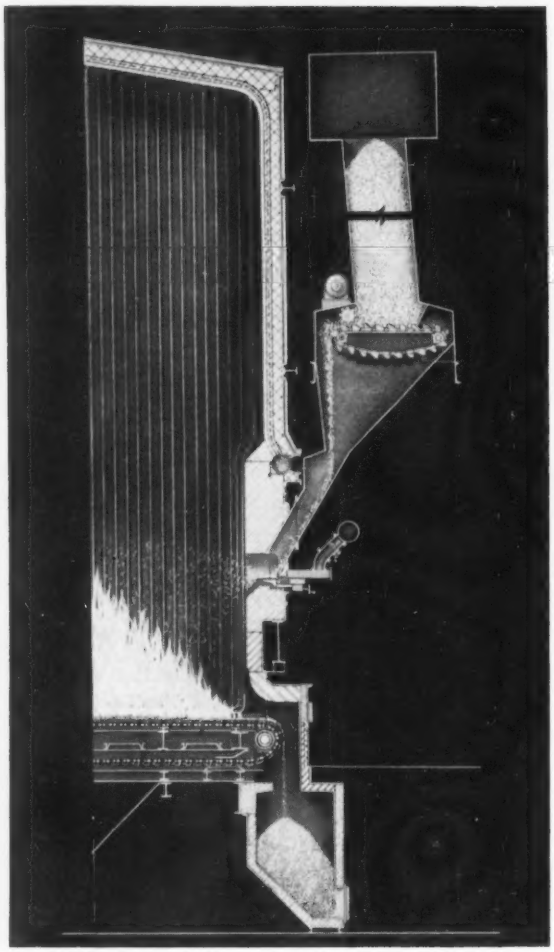
**Old steam - generation equipment.** The existing boilers at Puunene mill date back to 1914. From that date to 1924, sixteen 285-hp hrt boilers, designed for 150 psi, were installed. These have step grates for burning bagasse.

In 1929 and 1939, two 800-hp Walsh & Weidner sectional-header boilers were installed. They operate at 300 psi, 575 F, burn oil or bagasse.

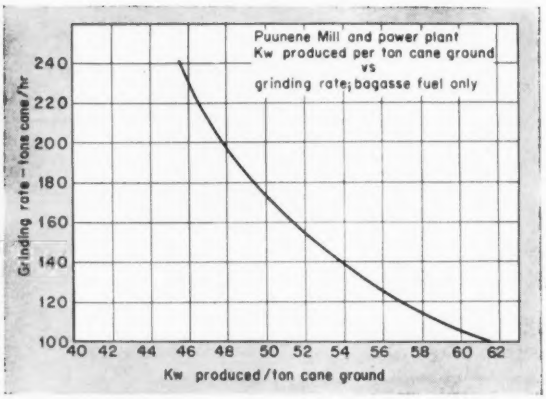
In 1951, when steam demand rose above generating capacity because of increased grinding rates, two 800-hp B&W Stirling boilers were moved in from a recently electrified water-pumping plant (POWER, April, 1955, p 101). These boilers were modified to increase their capacity to 50,000 lb per hr each. This move relieved the steam shortage and allowed the sugar plant to operate at the desired capacity.

**Old electric generation equipment.** Before the recent additions, electric energy could be generated as follows:

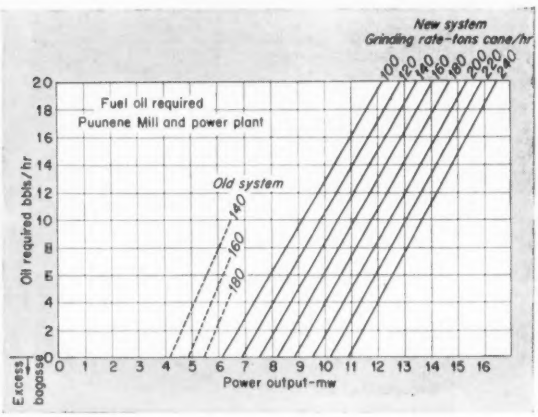
(1) Kaheka hydro: three units at 1333 kw; static head 660 ft. Plant cannot be considered for firm power because of the large variation in water supply. (2) Paia hydro: one unit at 800 kw; static head 300 ft; water supply same as for Kaheka plant. (3) Paia mill: one unit at 4000 kw; throttle pressure 150 psi; automatic extraction at 12 psi and condenser. (4) Puunene mill: two backpressure units at 750 kw; throttle pressures 150 to 12 psi. Also at Puunene mill: one unit at 4000 kw; mixed pressure turbine with throttle pressure 300 psi at 575 F, with induction point for 150 psi; automatic extraction controlled at 12 psi and condenser. (5) Central power plant: four units totaling 6000 kw; throttle pressure 200 psi at 540 F; all condensing punits burning oil only. This old, low-pressure plant is now on a standby



**BAGASSE HOPPER,** feeder, distributors and connecting chute for first h-p boiler. This unit uses multiple-chain feeders




**ENERGY** we can generate, using one boiler burning bagasse at various cane grinding rates, calculated for fixed conditions




**SUPPLEMENTARY** oil requirements decrease as new equipment makes more efficient use of bagasse fuel in Puunene mill

## Bagasse available relates to grinding rate

Bagasse is a byproduct remaining after sugar juice is extracted from the cane. At Hawaiian Commercial & Sugar Co, it is burned as fuel. Because of the high requirements of electric energy, the bagasse is usually supplemented with oil to produce the power required (see charts above).

As plant modernization progresses, amount of "bagasse power" available is increasing. With two new boilers in operation, plant gets about 65 kwhr per ton cane ground without supplementary oil. Performance varies as moisture in fuel fluctuates, amount of evaporation needed changes, etc.

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basis; it is operated only during periods of emergency.

Total capacity of these units is 20,300 kw, including 6000-kw standby and 4800-kw non-firm hydro.

The electrical system is connected with the Maui Electric Company. A power interchange agreement allows the sugar company to purchase power on a no-demand basis and provides an outlet for surplus power. Provisions for emergency breakdown service are included in the contract. This agreement is a definite advantage to both of the companies.

**Design engineering.** The Bechtel Corporation of San Francisco made the preliminary studies and final design for improvements. Their study covered power and steam requirements under a wide variety of conditions, and investment and operating costs.

The large requirements for power and low-pressure steam at 150 and 12 psi led to selection of a 7500-kw condensing turbine-generator with throttle conditions of 850 psig, 750 F. It has automatic extraction at 150 psi for mill engines and existing low-pressure turbine-generators that supply 12 psi steam

# PRINCIPAL POWER PLANT EQUIPMENT

## New units at Puunene Mill, Hawaiian Commercial & Sugar Co. Ltd

### Steam-generating equipment

Boilers, 2 — Riley Stoker Corp
Two-drum, type RX-29, heating surface 15,434 sq ft; waterwalls 2590 sq ft; tubular air heater 18,700 sq ft; furnace volume 7180-cu ft; operating conditions 900 psig, 760 F

| Fuel | Bagasse | Oil |
|---|---|---|
| Max cont cap, lb per hr | 125,000 | 165,000 |
| Exit gases, F | 740 | 715 |
| Leaving air heater, gases, F | 450 | 380 |
| Max air temperature, F | 560 | 495 |
| Heat release, Btu per cu ft | 28,200 | 28,200 |
| Heat release, grate KBtu per sq ft | 816 | |

Traveling grates — Riley Stoker Corp
Area, 248 sq ft; hydraulic drive equipped with control valve for grate speed regulation
Fans, 2 f-d, 2 i-d — American Blower Corp
F-d fans, double inlet, nominal performance 45,000 cfm, 9½ in. static pressure, 80 F, 1770 rpm, 150-hp motor drive; i-d fans, double inlet, nominal performance 103,000 cfm, static pressure 8.4 in. at 450 F, 870 rpm, 300-hp motor drive
Overfire air systems, 2 — Clarage Fan Co
75 hp, 1800 rpm, motor drive
Dust collectors, 2 — Western Precipitation Corp
Type 9VG12, size 160-10
Water columns, 2 — Diamond Power Specialty Corp
Stack and breeching — Central Pacific Boiler Works
Self-supporting, 150 ft high, 11 ft ID, brick lined

### Power-generating equipment

Turbine-generator, 1 — General Electric Co
Turbine, 7500 kw, 3600 rpm, 850 psig, 750 F, 2 in. Hg abs back-pressure, 180,000 lb per hr at 150 psig automatic extraction point. Generator, 3 phase, 0.8 pf, 60 cycle, 11,500 v, 10,000 kw
Condenser, 1 — Westinghouse Electric Corp
7000 sq ft, 2 pass, horizontal surface
Circulating-water pumps, 2 — Johnston Pump Co
Deep well, each 4200 gpm, 125-ft head; motor, vertical, 150 hp, 1760 rpm
Condensate pumps, 2 — Westinghouse Electric Corp
Vertical, 220 gpm, 200-ft head; motor 20 hp, 1760 rpm
Air-removal equipment — Westinghouse Electric Corp
Two stages with hogging jet

### Feedwater equipment

Deaerating heater, 1 — Swartwout Co
Capacity 300,000 lb per hr, vertical tray type, operating pressure 15 psig
Boiler-feed pumps, 3 — Ingersoll Rand Co
Capacity 330 gpm, 2680-ft head, eight stages; 2 motors: 300 hp, 3600 rpm; 1 turbine: 350 hp, 3600 rpm, operating pressure 150 and 200 psig, backpressure 15 psig
High-pressure heater, 1 — Westinghouse Electric Corp
Operating pressure 150 psig, heating from 235 to 360 F, capacity 250,000 lb per hr
Evaporator, 1 — Westinghouse Electric Corp
Net capacity 6000 lb per hr at 10 psig when supplied with steam at 25 psig; 650 sq ft heating surface

### Fuel-handling equipment

Bagasse conveyors — Hawaiian Commercial & Sugar Co
Bagasse feeders No. 1 boiler — Riley Stoker Corp
No. 2 boiler — Hawaiian Commercial & Sugar Co
No. 1: Multiple chain drag-type feeders with individual 1-hp Varidrives for controlled firing; No. 2: double drum outward rotation and feeding units with individual Varidrives for controlled firing
Pneumatic distributors — Riley Stoker Corp
Fuel-oil heater, 1 — Peabody Engineering Corp
Capacity 30 gpm, 400-psig discharge, heating from 80 to 250 F, designed for No. 6 fuel oil
Fuel-oil pumps, IMO — DeLaval Steam Turbine Co
Motors, 15 hp, 1150 rpm, 440 v
Constant differential pumps, 2 — United Centrifugal Pumps
Type ES, two stages, suction 375 psi, discharge 525 psi
Fuel-oil burners, 8 — Peabody Engineering Corp
Mechanical atomizing type AB wide range

### Instruments and controls

Combustion control, No. 1 boiler — Republic Flow Meters Co
No. 2 boiler — Bailey Meter Co
Feedwater control, 3 element, No. 1 boiler — Republic Flow Meters Co
No. 2 boiler — Bailey Meter Co
Flow meters, No. 1 boiler — Minneapolis-Honeywell Regulator Co
No. 2 boiler — Bailey Meter Co
Temperature recorders,
No. 1 boiler — Minneapolis-Honeywell Regulator Co
No. 2 boiler — Bailey Meter Co
Draft gages, No. 1 boiler — Republic Flow Meters Co
No. 2 boiler — Bailey Meter Co
Level control valves, No. 1 boiler — Fisher Governor Co
No. 2 boiler — Bailey Meter Co
Pressure-reducing valves — Republic Flow Meters Co
Reducing-valve controls — Minneapolis-Honeywell Regulator Co
Desuperheaters — Republic Flow Meters Co
Boiler and turbine boards — Minneapolis-Honeywell Regulator Co

### Miscellaneous equipment

Air compressors, 2 — Ingersoll Rand Co
Carbon ring, capacity 53 cfm each, size 6 x 7; 15-hp motors
Valves — Pacific Valves, Inc
Edward Valves, Inc
Boiler safety valves — Manning, Maxwell & Moore, Inc
Pressure-reducing safety valves — Farris Engineering Co
Traps and strainers — Yarnall-Waring Co
Switchgear — General Electric Co
Westinghouse Electric Corp
Transformers — General Electric Co
Main electric controls and relays — General Electric Co
Annunciators — Western Switch Board Co
Oil circuit breaker — Westinghouse Electric Corp
Motors — Allis-Chalmers Mfg Co
U.S. Electrical Motors, Inc
General Electric Co
Elliott Co
Auxiliary turbine — Elliott Co

**Consulting Engineers** — **Bechtel Corporation**

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for process. The consultants recommended installing one or two boilers, each having a capacity of 125,000 lb per hr, depending on immediate requirements. To expedite the project, one boiler was selected for immediate installation and the second installed shortly thereafter.

Auxiliary equipment was designed for two-boiler capacity wherever practical: i.e., feedwater storage, deaerating heaters, high-pressure heater, evaporator, fuel oil heaters, stack, etc. And, the original layout allowed space for additional equipment when the second boiler was installed. Because rainfall is slight, boiler and feedwater stations were designed for outdoor operation.

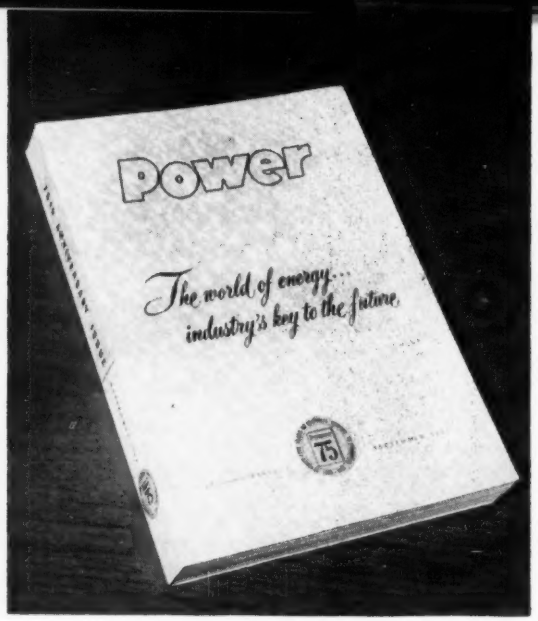
Flow diagram, p 95, shows how new units tie in with older plant equipment.

**New power plant equipment.** The turbine described above has maximum throttle flow of 214,000 lb per hr, and maximum extraction 200,000 lb per hr to provide steam for the sugar mill and for the low-pressure turbines in the power plant.

Generator is rated at 10,000 kw, 0.8 pf, 12,500 kva, 11,500 v, 3 phase, 60

(*Continued on page* 188)

**Coming in September:**
**POWER's *most significant issue...***




# The spectacular story of "ENERGY—U.S.A."

**How abundant, low-cost energy has transformed our American economy and how tomorrow's technology will meet the soaring energy needs of more people with ever-higher living standards**

► THAT's "ENERGY—U.S.A."; a story that began 75 years ago when POWER was born as the electrical revolution got under way; that will continue in the years ahead, as the nuclear revolution gathers headway. And that's the story told in the three major sections of POWER's anniversary issue:

**75 years of power progress:** No dry-bones treatise could convey the tremendous excitement of the 75 years just past, nor throw into sharp focus their deep significance to all of us. This historical section, dealing with the great tides of change that have swept the power world since 1882, will tell its dramatic story largely in pictures, supported by concise text.

**The power field today and tomorrow:** This section will probe each area of the power field, evaluating present practices and trends, appraising the development to be expected in the years immediately before us. By interview and correspondence, we have sought the thinking of leading consultants, of major equipment manufacturers, of plant designers and power-service men throughout industry. The result will be a group of eight survey reports, a timely and authoritative statement of where we stand, where we are headed.

**Energy—the key to the future:** Continued dynamic growth depends on our ability to use present energy sources wisely and to tap new ones. To this theme, the issue's third section addresses itself, speaking to both engineer and layman. In a unique visual presentation, it will delve deep into the complex world of energy. It will show the myriad ways man harnesses energy, appraise future needs against today's resources, explore new sources we will exploit by the year 2000.

These major features, plus others, add up to more than 200 editorial pages. This largest—and most significant—issue in POWER's history will be rounded out by an unusual wealth of product information in the advertising pages. To match the importance of the contents, we will clothe this issue in a crystallon cover and use a special form of binding so it will open flat. Of necessity, production will be slowed, but we will mail copies as fast as they come from the bindery. Watch for yours—this issue is worth a little waiting!

# Power's DATA SHEET

No. 302

## Stresses for seamless condenser tube (No desuperheater), psi

| Steam pressure psig | Metal wall temp F | Admiralty | 90-10 Cu-Ni | 80-20 Cu-Ni | 70-30 Cu-Ni | Red brass | Mónel, stress-relieved | Monel, annealed | Copper, Light drawn | Copper, Hard drawn |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 297.66 | 10,000 | 9309 | 10,305 | 10,809 | 8000 | 19,516 | 15,523 | 8014 | 8117 |
| 100 | 337.88 | 8485 | 9073 | 10,148 | 10,648 | 6485 | 19,386 | 15,235 | 5727 | 5727 |
| 150 | 365.85 | 7049 | 8905 | 10,026 | 10,505 | 5049 | 19,302 | 15,039 | 4207 | 4207 |
| 200 | 387.77 | 5734 | 8773 | 9949 | 10,373 | 3734 | 19,200 | 14,886 | 3111 | 3111 |
| 250 | 406.20 | 4752 | 8650 | 9863 | 10,275 | 2876 | 19,200 | 14,794 | | |
| 300 | 421.73 | 4131 | 8526 | 9770 | 10,213 | 2565 | 19,200 | 14,778 | | |
| 350 | 435.64 | 3574 | 8415 | 9686 | 10,157 | 2287 | 19,200 | 14,764 | | |
| 400 | 448.13 | 3075 | 8315 | 9611 | 10,107 | 2037 | 19,200 | 14,752 | | |
| 450 | 459.53 | | 8148 | 9543 | 10,062 | | 19,200 | 14,741 | | |
| 500 | 469.99 | | 7980 | 9480 | 10,020 | | 19,200 | 14,730 | | |
| 550 | 481.59 | | 7795 | 9410 | 9974 | | 19,200 | 14,718 | | |
| 600 | 488.81 | | 7679 | 9367 | 9945 | | 19,200 | 14,711 | | |
| 650 | 499.00 | | 7516 | 9306 | 9904 | | 19,200 | 14,701 | | |
| 700 | 505.42 | | 7413 | 9257 | 9889 | | 19,200 | 14,700 | | |
| 750 | 514.54 | | 7267 | 9184 | 9871 | | 19,200 | 14,700 | | |
| 800 | 520.33 | | 7175 | 9137 | 9859 | | 19,200 | 14,700 | | |
| 850 | 528.62 | | 7042 | 9071 | 9843 | | 19,200 | 14,700 | | |
| 900 | 533.90 | | 6958 | 9029 | 9832 | | 19,200 | 14,700 | | |
| 950 | 540.26 | | 6856 | 8978 | 9819 | | 19,200 | 14,700 | | |
| 1000 | 546.36 | | 6758 | 8929 | 9807 | | 19,200 | 14,700 | | |
| 1050 | 552.26 | | 6668 | 8877 | 9791 | | 19,200 | 14,700 | | |
| 1100 | 557.94 | | 6589 | 8829 | 9768 | | 19,200 | 14,700 | | |
| 1150 | 563.44 | | 6512 | 8766 | 9746 | | 19,200 | 14,700 | | |
| 1200 | 568.75 | | 6437 | 8712 | 9725 | | 19,200 | 14,700 | | |
| 1250 | 573.90 | | 6365 | 8661 | 9704 | | 19,200 | 14,700 | | |
| 1300 | 578.90 | | 6295 | 8611 | 9684 | | 19,200 | 14,700 | | |
| 1350 | 583.75 | | 6227 | 8562 | 9665 | | 19,200 | 14,700 | | |
| 1400 | 588.46 | | 6162 | 8515 | 9646 | | 19,200 | 14,700 | | |
| 1450 | 593.05 | | 6097 | 8469 | 9628 | | 19,200 | 14,700 | | |
| 1500 | 597.50 | | 6035 | 8425 | 9610 | | 19,200 | 14,700 | | |

► THESE STRESS VALUES are used to calculate thickness of seamless condenser tubes when the higher pressure is inside the tube. Use them with these formulas:

$t = (P \times d)/(2S + .8P)$ for straight tubes, and

$t = (P \times d)/(2S + .8P) \times (1 + d/4R)$ for U-bends where dual-gage tubing provides greater thickness in the bent section than in the straight section.

$t$ = tube wall thickness, in. (before bending)
$d$ = outside diameter of tube, in.
$P$ = design pressure, psig
$S$ = allowable design stress, psi
$R$ = radius of bend at center line of tube, in.

All values in the table are for tension, not compression. The stress values have been interpolated from the 1956 ASME *Code*.

For determining material and thickness, tube metal temperature is assumed equal to the saturation temperature corresponding to design pressure on the shell side; except in desuperheating zones, where tube metal temperature is considered to be not more than 35 F above the saturation temperature just described.

Next *Data Sheet* gives values for seamless condenser tube stresses where there is a desuperheater.

GEORGE F HAUSENBAUER, *Alco Products, Inc*

**POWER pays $35 for each accepted *Data Sheet*. Why not submit yours today?**

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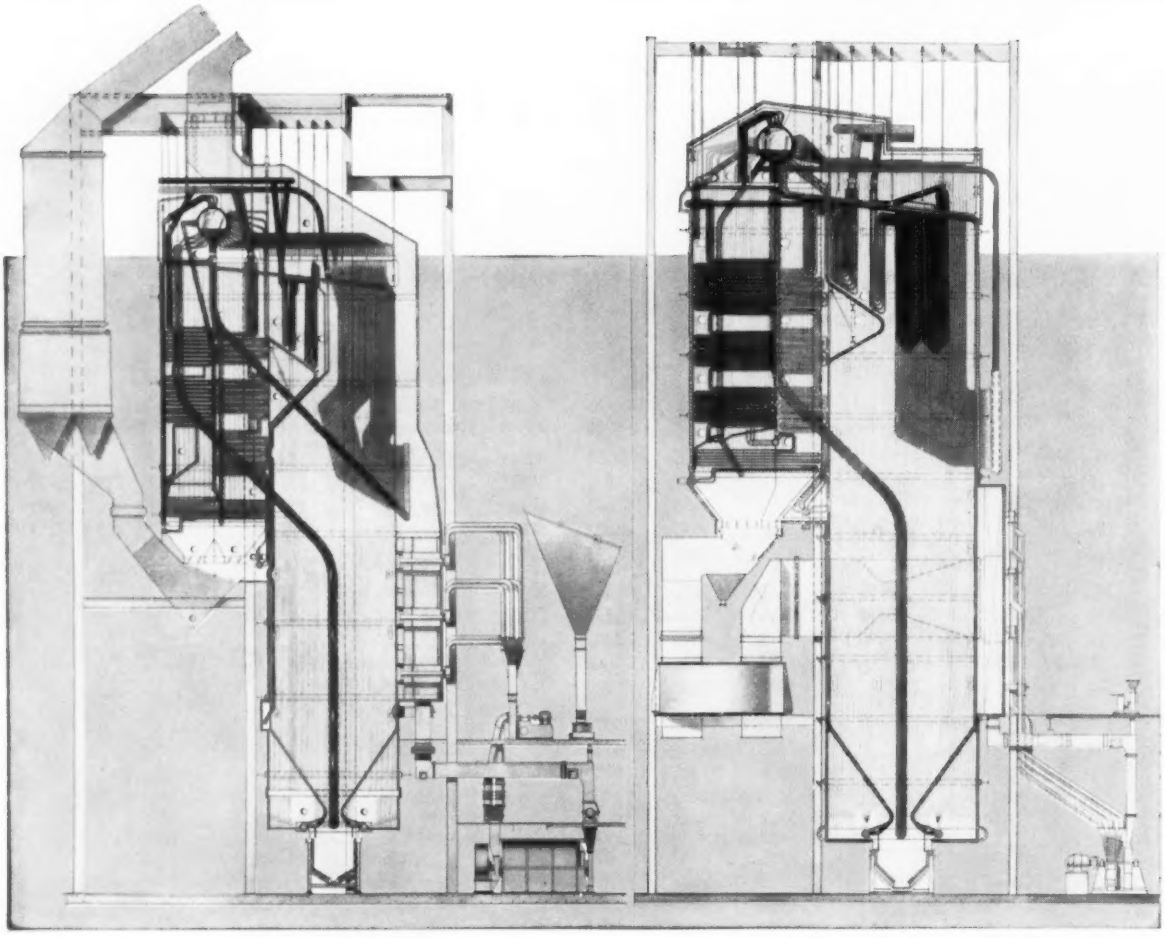


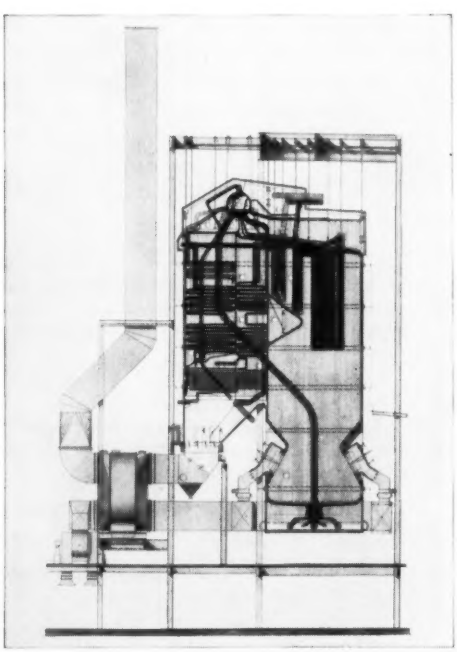
**Public Service Co. of Indiana, Inc. — New Albany**
Two Units — 1,000,000 lbs/hr; 2075 psig; 1005/1005 F
Sargent & Lundy, Consulting Engineers

**The Hartford Electric Light Co. — Middletown, Conn.**
800,000 lbs/hr; 2100 psig; 1005/1005 F
Stone & Webster Engineering Corp., Consulting Engineers

# *The* RILEY TURBO FURNACE

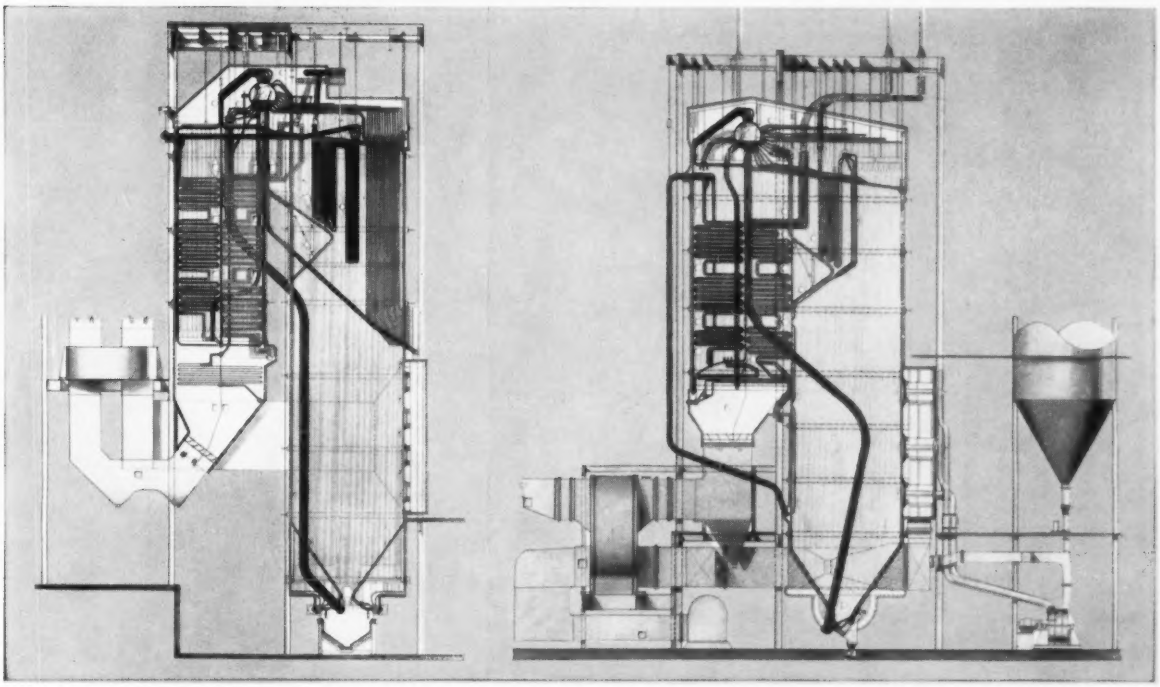
## *the design of the future that's* HERE!

Since late 1955, when this design was first announced, 19 Riley TURBO FURNACE boilers in capacities from 150,000 to 1,600,000 lbs/hr have been sold, eight of them to public utilities. This rapid acceptance is a result of the TURBO FURNACE'S exceptional performance characteristics and its ability to utilize multiple fuels. Users, burning oil or gas initially, can switch to solid fuels in the future without the costly delay caused by conversion of furnace and heating surfaces. A wide range of coal, lignite or other solid fuels can be burned; with fly ash reinjection in the furnace unburned losses are negligible. In addition, the Riley TURBO FURNACE boiler has all burners on one level with a consequent reduction in overall height.



# Current RILEY Reheat Designs

## PULVERIZED COAL FIRED



**Central Illinois Light Company — R. S. Wallace Station**
690,000 lbs/hr; 1650 psig; 1000/1000 F
Commonwealth Associates, Inc., Consulting Engineers

**Minnesota Power & Light Co. — Clay Boswell Station, Duluth**
Two Units — 500,000 lbs/hr; 1725 psig; 1005/1005 F
Ebasco Services, Inc., Consulting Engineers

The use by public utilities of Riley Reheat Units for all capacities and steam conditions has climbed rapidly and steadily during the past decade. This gratifying acceptance is the result of the record of performance, dependability and continuity of operation established by Riley units.

The designs illustrated on these pages are typical of those currently being supplied for pulverized coal firing. They are just a few of many Riley central station designs. Let our sales engineers show you others.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

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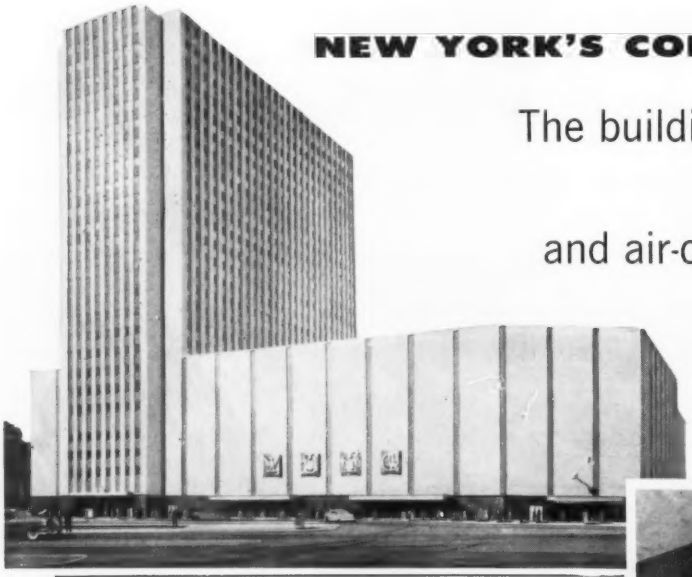
## NEW YORK'S COLISEUM—

The building that "has everything"
has heating
and air-conditioning systems of

# NATIONAL PIPE



**OWNER:** Triborough Bridge & Tunnel Authority
**ARCHITECTS:** Leon & Lionel Levy
**CONSULTING ARCHITECTS:** Eggers & Higgins, John B. Peterkin, Aymar Embury III
**GENERAL CONTRACTOR:** Walsh-Fuller-Slattery
**HEATING & AIR CONDITIONING:** Almirall & Company, Inc.
**MECHANICAL & ELECTRICAL ENGINEERS:** Guy B. Panero Associates
**STRUCTURAL ENGINEER:** Dr. Jacob Feld

New York City's Coliseum is one of the most distinctive and functional structures ever conceived. Its 26 floors and giant exhibition hall comprise an auditorium area capable of seating over 10,000 persons, approximately 1,000,000 sq. ft. of usable floor space, and an 850-car underground garage. Except for the garage, the building is completely air conditioned.

More than 376 tons of National Pipe were used in the heating and air-conditioning systems of the new structure. The office building area requires 1,500 tons of refrigeration; the Coliseum proper requires 2,500 tons. Four compressors supply 4,000 tons of refrigeration for the high-pressure air-conditioning system.

Purchased steam is delivered at 125 to 150 psi. Pressure-reducing rigs reduce it to 50 psi and 5 psi for distribution throughout the buildings. Steam requirements are about 102,000 lbs. per hour for comfort heating and auxiliary uses.

Possessing a solid reputation for dependable service, USS National Pipe is the choice of engineers and contractors throughout the country for air-conditioning, heating and power installations. It is synonymous with efficient, satisfactory service under all types of pressure and temperature conditions. For more complete information, get in touch with us. For technical assistance, our engineering staff is at your service.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

# NATIONAL PIPE

UNITED STATES STEEL

STEVE ELONKA
*Associate Editor in Charge*

**Welding cast iron is easy, and you save time and money when you . . .**

# Get broken castings back on the job

By H C WAUGH
*Mechanical Engineering Section*
*International Nickel Co, Inc*

► IT'S UNIVERSALLY ACCEPTED, NOW, that cast-iron parts can be repaired by the metal-arc welding process. But what isn't generally appreciated is the fact that these welds can be not only strong, but ductile enough to permit saw, shaper, lathe and drilling operations.

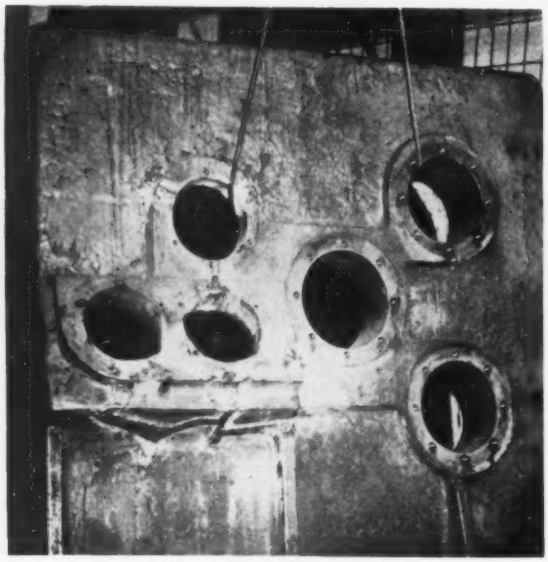
In many cases, cast-iron repair isn't worthwhile unless the joint can be machined after welding. Very often, the job involves a surface that must be finished to specified tolerances and dimensions in order to fit a mating part.

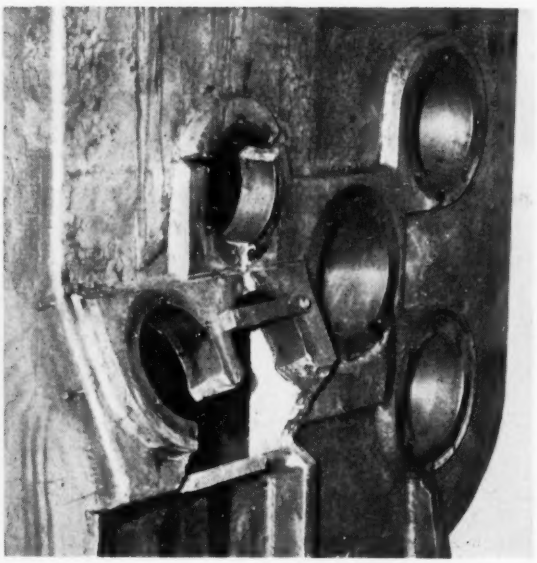
Time was when a welding operator would shake his head dubiously when asked to repair a broken cast-iron section. In those days, he was using mild-steel electrodes, and while he might not have been able to spell it out in metallurgical language, he could have told you that cast-iron welds always cracked.

Unlike mild steel, cast iron isn't ductile. It isn't capable of plastic deformation, can't absorb stresses set up by arc-welding's high temperatures. Consequently, as weld cools, the *weld* metal tries to carry the load of shrinkage stresses and invariably cracks.

**Alternative repair** method is called *studding*. Studs are screwed into holes drilled and tapped on each side of a fracture in a casting. Spaced at about the same pitch that rivets would be, the studs project above surface, act as anchor points for weld metal laid on with mild-steel electrodes. It's, in effect, a welded butt strap over the fracture.

Strengthwise, a properly executed





**Here are typical examples of how the right electrode and correct procedure...**

studding repair has a transverse strength equal to the shear value of the studs. However, shrinkage stresses get in their licks at the weld metal, cause it to pull away from the surface of the casting. Obviously, that kind of joint won't be leaktight against liquids or gases, nor will it lend itself to a machining operation.

Then, nickel electrodes came down the pike. They proved popular for maintenance welding and, in general, did a good job, provided they weren't used on thick sections and the welds weren't restricted. If so, the weld metal was apt to crack.

**Electrode development** and research improved the nickel electrode and brought about the nickel-iron electrode. Today, sound machinable welds are being made on ordinary cast-iron and high-phosphorous cast-iron sections of all sizes and thicknesses with pure nickel and nickel-iron electrodes (55% nickel, 45% iron). Both rods are easy to handle and welding can be done in any position—though downhand is easier. In many cases, preheat and postheat aren't necessary—important when jobs involve large castings, or when preheat might cause distortion in adjacent members.

What's the secret in getting successful welds with these rods? Just two factors: (1) Use the right electrode for the job and (2) follow the correct welding procedure. Choice of the rod must be governed by the job at hand. Generally, the pure nickel rod is best for general-purpose work with cast iron—particularly where thin sections are involved or machinability is important. On the other hand, nickel-iron rod is preferred for heavy sections, high-phosphorous irons, ductile iron, austenitic cast iron, high-strength cast iron and for joining cast iron to other metals.

**Welding procedure** is simple, but should be followed carefully to get good results. First of all, the surface *must* be free from oil, water, rust or other foreign matter. Grind off the skin; it may contain sand or other impurities from the mold. If the casting is oil-impregnated or gassy, heat it in an oven to about 1000 F, or flash it to a dull red with a torch.

Next step is joint preparation. V- and double-V type joints, having a 60 to 75-deg included angle, are generally best for metal-arc welding. For extremely heavy sections, use a U or double-U groove with a 10 to 12-deg side angle and 3/16 to ¼-in. root radius. Prepare edges by grinding, chipping or machining.

Though preheating often can be eliminated by using nickel and nickel-iron electrodes, it's beneficial in many cases and should be used—time and type of job permitting. Preheat and slow cooling tend to relieve stresses and produce softer metal across the weld and parent-metal area known as the *heat-affected zone*. For best results, preheat temperature should be from 300 to 600 F unless the job requires a pressure-tight weld. If so, preheat temperature should be higher. The skip technique and multiple passes distribute welding heat more uniformly and often provide an adequate substitute for preheat.

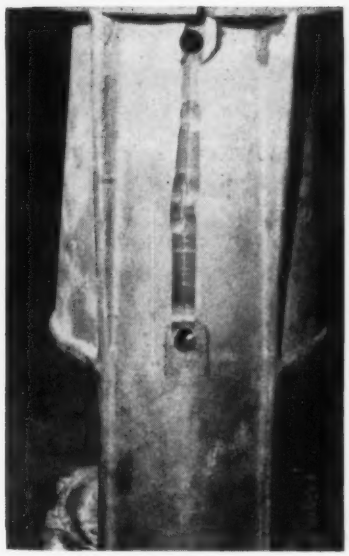
**Welding current** should be as low as is consistent with smooth operation, good bead contour and good "wash." Amperage chart, below, shows values for flat or downhand welding. These values should be reduced by 5 to 15 amp for overhead, 10 to 20 amp for vertical positions.

| *Electrode size* | *Ac* | *Dc* |
|---|---|---|
| 3/32 in. | 50-90 amp | 40-80 amp |
| 1/8 in. | 90-120 amp | 80-110 amp |
| 5/32 in. | 120-150 amp | 100-140 amp |
| 3/16 in. | 130-170 amp | 120-160 amp |

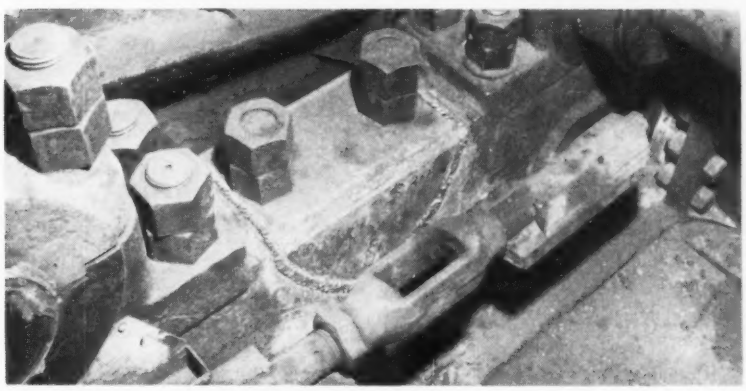
**Arc length** should be about the same as that for mild-steel electrodes. Remove slag from each crater before restriking the arc, and from each pass before starting subsequent pass.

In welding cast iron, or cast iron to other metals, the deposited weld metal is bound to have a different coefficient of expansion than the parent metal. Because of this difference, there'll be some residual stresses in the heat-affected zone after cooling. In many cases, it's possible to reduce these stresses and cut down on possible distortion by *peening*. The theory: *stretching* or inducing mild plastic flow gives the weld metal a chance to relieve itself of some of the locked-up stresses. The time to peen the weld metal is immediately after laying down each pass. Remove all slag and peen with a round-nosed or ball-pointed tool with blows strong enough to move the metal but not rupture it. (*Don't* use a flat or sharp-nosed tool.)

**Preheating,** important enough to reconsider for a moment, will always be



**cut downtime to hours . . . expenses to the bone . . .**



**by saving costly equipment from the scrap pile**

governed by the individual repair job. The chemical composition of the casting is all-important in selecting preheat temperature. Cast iron contains carbon in two forms: combined carbon (in solution, as in steels) and free carbon (in the form of tiny carbon flakes).

When free carbon volume in the base metal is very high, it may infiltrate the weld metal to such an extent that it all can't be held in solution. When this happens, the excess carbon settles out (precipitates) along the grain boundaries. Result: The weld metal is weaker and the shrinkage stresses set up during joint cooling relieve themselves in the form of cracks or fissures.

**High sulfur content** of the base metal can also complicate the welding job, particularly when phosphorus content runs near the allowable limit. In making a cast-iron repair, it may or may not be necessary to preheat to reduce or eliminate the hard, brittle zone adjacent to the welded joint in order to get the best possible degree of machinability. If preheat is used, however, the more you know about the makeup of the cast iron, the easier it'll be to choose the right temperature.

**Post welding** heat treatment, too, must be an individual job consideration. It involves a time-temperature relationship governed by the composition of the cast iron, section thickness involved and degree of softening desired. In addition to conventional post heating, there's another scheme used to get some measure of hard-zone reduction. It's an easily-applied, practical method known as the "annealing bead technique." The procedure calls for deposition of an additional bead on top of the previously deposited weld metal, with care being taken not to let the top pass come in contact with the cast iron. Heat input supplied by this pass tends to reduce hardness in the heat affected zone.

Proof of any pudding is in the eating and the same principle holds true for any welding procedure. Let's look at some cast-iron repair jobs that saved thousands of dollars by keeping a broken part from the scrap pile:

**Crack** in the bottom of a 14-in. valve, photo, p 103, installed in a condenser cooling water line, was repaired in only eight hours without preheat. Using nickel-iron electrodes, the weldor wire-brushed and peened each of the nine passes required. After welding, an asbestos blanket was placed over the valve to retard cooling.

**Broken tooth** lodged between gears, damaged a 5-ton gear case badly, photos, p 104. A new casting meant plenty of expense, plus a two-month wait for delivery. Welded repair took 24 hours. Weldor used nickel-iron rod, no preheat, peened after each pass. After welding, bearing area was machined to original dimensions.

**A rock** tore through the side of the 12-in. discharge dredge-pump casing, photo, top left. It was repaired in less than six hours with steel patches. Nickel-iron electrodes were used because of the heavy section, dissimilar metals and advantage of no preheat.

Reciprocating water-pump jacket froze, then cracked, photo, top right, but was back on the job in 24 hours. Weldor drilled holes at ends of crack to stop propagation, heated casing with torch for 1½ hr to 500 F. Asbestos wrapping kept it hot while it was welded with ⅛-in. nickel-iron rod. Each bead was peened, no postheat was used and the casting was cooled slowly in powdered lime.

**Car dumper,** capable of picking up and emptying twenty-one 75-ton hopper cars an hour, was put out of commission when an anchor bolt let go, fracturing the cast-iron member holding a main drum bearing, bottom photo. Operators, visualizing a long shutdown, tried to rig a turnbuckle-and-hook splint (shown in photo) that would hold the broken member in tension and keep the dumper in service until a new casting could be delivered; a nice try, but it wouldn't work. But welding did, and so well that a permanent part wasn't needed. A 1-in. boiler plate channel was welded into the hollow of the casting. Then a 1-in. steel plate was welded over the fracture. Using 35 lb of nickel-iron welding rod, the job was finished in 20 hours.

STEAM

# How to use your stack "pump"

By R B ENGDAHL, *Battelle Memorial Institute*
and AUBURN SMITH, *Columbia Gas System*

► ANY STACK or chimney is a "pump." A comparatively weak one, it's agreed, but a reliable one. We can clarify the problem of stack and draft for any combustion device if we look at it from the overall standpoint of air supply.

Boilers are like living things; they need air (oxygen) and if they don't get it, they can't function. For some boilers, the stack pumps air to them and pumps waste gas away. For others, the stack simply moves combustion gas away.

Our habit of specifying this pump only in terms of the draft it will produce has resulted in considerable confusion. We don't specify water pumps in this manner because we know that a pump's discharge pressure isn't the whole story. We always specify flow rate, too. And so it should be for a stack. We must know the draft or negative pressure that a stack will produce and, just as important, its blow capacity.

**How does a stack "pump?"** It pumps because of the difference in pressure caused by two vertical columns of air. Drawing, p 107, serves to illustrate the principle of any stack. When the column of air in the stack is at the same temperature as the air in the imaginary column outside, there's no pressure differential and no air is pumped. But when the air in the stack is either heated or replaced by hot flue gas, the pump goes to work. Weight of the hot column decreases because its density is less than outside column density. Greater weight of the outside column pushes air into building and up stack.

Now, if we put a piece of equipment, such as a boiler, in the path between the two columns of air, the pump encounters resistance to flow and we get a pressure drop through the boiler. Pressure around the boiler is usually

atmospheric if the boiler has a good air supply. So, boiler outlet pressure must be less than atmospheric if we're to have flow. We call this low pressure at the boiler outlet stack *draft*, but it's really pressure head that our pump's working against.

**Theoretical draft.** For the special condition where there's no gas movement, we can calculate a so-called theoretical draft or pumping head from this equation:

$$\text{Draft} = 0.2554 \text{ barometer} \times \text{height} \times \left( \frac{1}{\text{outside temp} + 460} - \frac{1}{\text{stack temp} + 460} \right)$$

or in abbreviated form:

$$D = 0.2554\, BH \left( \frac{1}{T_a} - \frac{1}{T_s} \right)$$

This is sometimes called *static draft* because it applies only to the ideal "no-flow" condition. As soon as we get flow, friction enters the picture. For each flow rate there's a friction loss which regulates the amount of fluid that the stack can pump.

The equation reminds us that aside from friction, the available pressure head or draft provided by the stack pump depends on (1) height (2) gas temperature (3) outdoor temperature.

We know that a pump will pump more fluid against a low-pressure head than against a high one. The same is true of our stack pump. It won't do much pumping if a boiler has excessively high rather than low resistance to air flow. So, for a boiler with high resistance, we may need a bigger pump. But "bigger" may not mean bigger in diameter or in cross-section—it may mean taller. We've seen that the taller the column of hot gas in the stack pump, the more pressure difference there will be at the stack inlet to do the pumping job. Sometimes, though, a larger pump may mean a diameter increase because the diameter decides how much internal friction of its own the stack must work against.

**Stack friction,** and hence the size, is important because it decides how much air will flow. And air flow controls amount of fuel that can burn in boilers that use the stack both to pump in air and to discharge flue gas. However, for boilers using forced-draft or downdraft diverters, either the burner itself or the burner fan supplies the right amount of air. Then, if the stack is too small (internal friction too high) it can't pump all of the hot gas supplied to it and some will leak out into the boiler room. This is known as *spillage.*

**Boiler manufacturers** usually specify the stack or "pump" size needed for their unit. However, our study shows that different manufacturers have widely different recommendations regarding stack friction. While a variety of equations can be used to calculate friction, they all channel toward one fact: Friction in any flow passage, be it pipe duct or stack, depends mainly on (1) the square of the velocity and (2) with constant flow volume, the fifth power of the diameter. True, other things, such as wall smoothness or roughness and temperature, affect friction to some extent, but velocity and diameter are the most important factors.

Let's consider a particular installation that puts out a constant volume of flue gas. Here, friction depends only on the diameter. To be exact, friction varies inversely as the fifth power of the diameter. This means that if $X$ equals friction for a 36-in. diameter stack, then friction will be $32x$ for a stack having an 18-in. diameter.

**At this point** you may say, "That can't be right. I know some plants working fine with a stack only half the size of some similar plants."

The answer to this one: The great majority of our plants have stacks so generously sized, and friction so small, that if we did multiply the friction by 32 (which is what we do when we cut the diameter in half), friction is still small enough to be within reason.

**A curve** (based on constant flow rate at a certain gas temperature) showing friction loss in inches of water plotted against stack diameter in inches will show that friction is negligible for the larger stacks. But when we choose a stack smaller than a certain size the friction curve will rise sharply. With existing stacks, a combination of tradition and experience has kept us on the safe side in most cases.

Plot manufacturer's recommendations against such a curve and you'll find that while friction is almost always low, there's a big difference in recommended sizes. It's obvious that an effort should be made to bring these recommendations into closer agreement.

**Our study** showed that:

(1) If friction drop per foot of stack is below 0.001 in. per ft, a boiler using a draft hood should work satisfactorily. If using a barometric damper instead of a draft hood, trouble may be caused by the damper lying wide open.

(2) If friction drop is between 0.006 and 0.015 in., a boiler with a barometric damper might be OK. However, it would be a good idea to calculate exactly the draft available at the boiler to be sure that it's more than enough to overcome draft loss through the boiler.

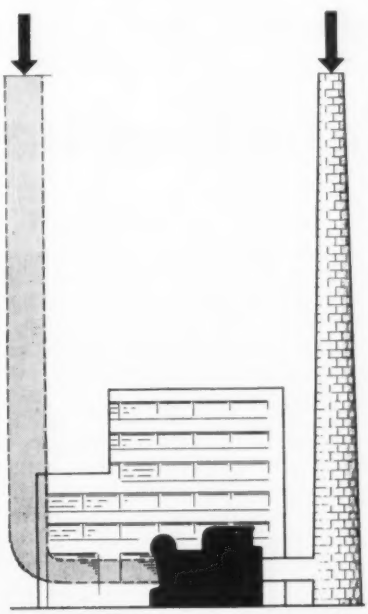
(3) If the friction drop is above 0.015 in. per ft, caution is the word because there may not be any available draft for the boiler.

**We're concerned** primarily with stacks that might be too small. If they haven't enough cross-section, friction loss will be too high and the stack will either fail to supply enough combustion air or spill some of the combustion products into the building. This latter condition may occur, paradoxically, with a stack that's too big in cross-section. It can happen when a conversion job involves connecting a 12 or 14-in. flue pipe to an existing larger stack. The stack itself is usually cold because the comparatively small amount of gas from the flue isn't enough to heat the large stack, particularly with on-off firing.

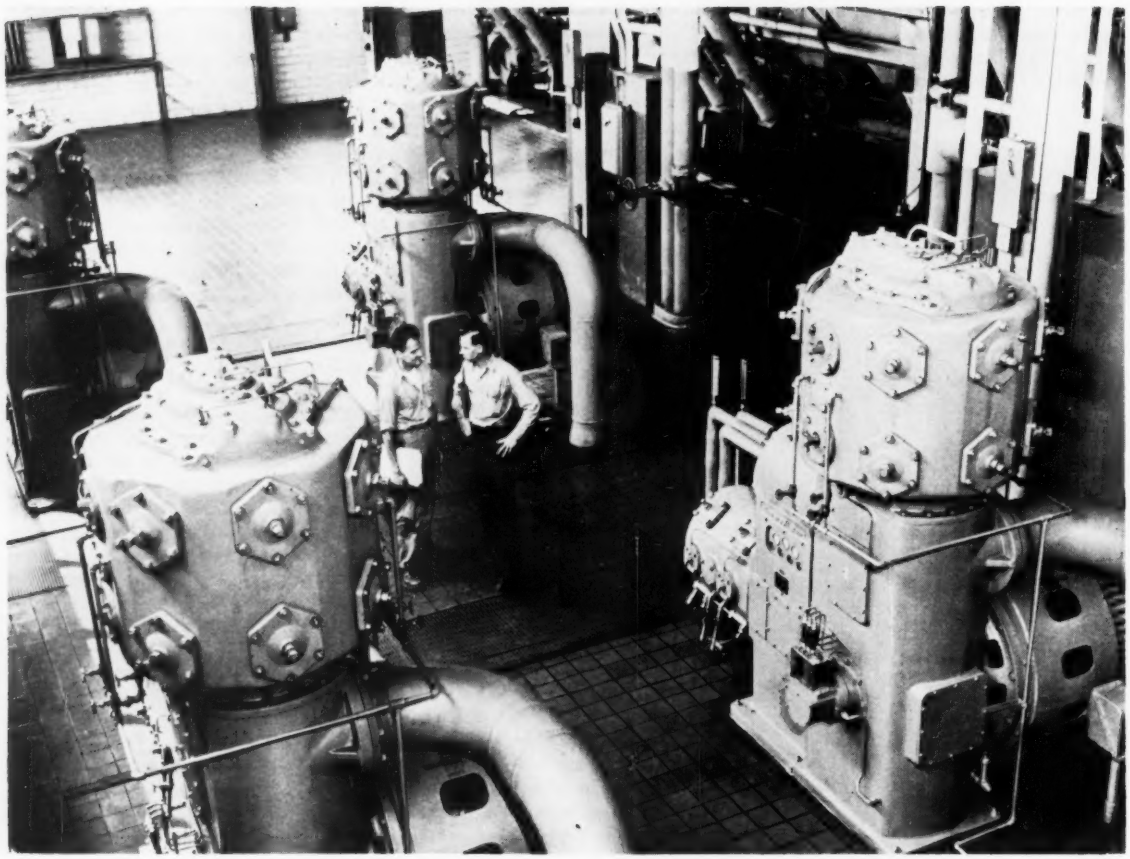
**Hot gas drifts** up one side of the stack, mixes with cold stack air. This cool mixture then flows down the opposite side of the stack. Couple this condition with a tight, air-starved boiler room, and the mixture may flow back into the boiler room through the draft diverter or barometric damper.

This brings up the matter of air supply. As we said earlier, the stack pump is weak, but reliable. However, if there's too much resistance to air flowing to the boiler room, the pump may fail. As advances in building construction reduce air leakage, more and more devices compete with the boiler for the dwindling supply. When combustion equipment is air-starved, it's the natural-draft stack that usually fails first.

**Induced-draft** can help solve the problem, but if there aren't enough air-supply openings, even the draft inducer may fail.



**STACK "PUMPS"** when gas column weighs less than outside imaginary air column



**L-DESIGN MACHINES** are compact, take up little space. These four 200-hp 1000-cfm air compressors supply general shop air in an engine manufacturing plant. Compressor room is centrally located, well-suited for this large industrial application

## What plant engineers should know about...

# Selecting and installing

► OBJECT OF INSTALLING a compressed-air plant is to provide at point of use enough air, at right pressures, for most efficient operation. Before determining how much air you need, carefully check on use of air power for all your services.

You must know what capacity to install. Many devices run almost continuously. Others operate infrequently but need a lot of air when in use. Amount of air used by a device varies largely with application.

So, learn the average air used by air-operated tools. Obtain this from manufacturers' literature, or make a test. Not all air-operated devices use maximum air at all times. Consider *load factor* of each air device in your plant.

**Load factor** brings up two items. First is time factor, or percentage of total time a device is in use. Second might be called work factor, or percentage of maximum work output per minute possible done by the device. For example, air used by a grinder with full open throttle varies greatly. It depends on how hard the operator pushes the grinder against the work.

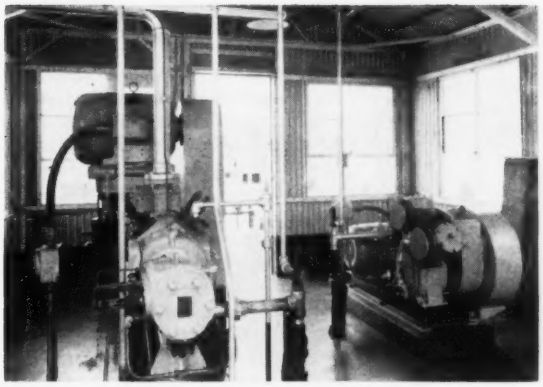
**Work factor** is ratio of air used under actual operating conditions to air used when tool is fully loaded. Load factor is product of time factor and work factor. In one shop, air consumed by 34 portable tools was only 15% of rated full-time air consumption.

It's common to add a percentage to calculated compressor capacity to compensate for leakage. But you must keep leaks in air system to an absolute minimum. Because compressed air has no odor, some plants overlook need for keeping system tight. But air leakage is very costly.

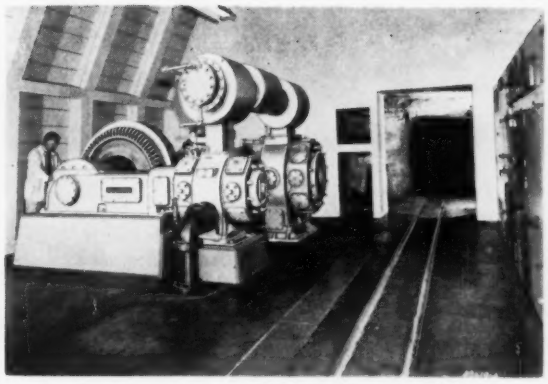
Always add a percentage to your calculated compressor capacity for future applications. Once you have air you'll find many new uses—so provide for it.

**Number of compressors** needed for total capacity is important. Compressors must be taken out of service at times. Weigh cost of standby capacity against value of production loss.

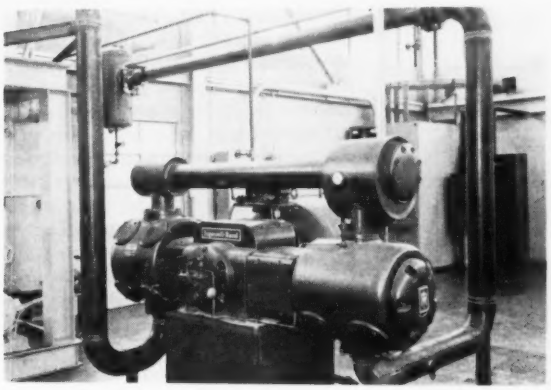
Many plants need a small volume of air continuously even when plant isn't



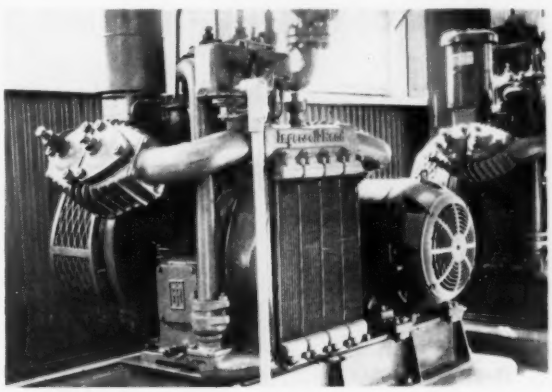
**HORIZONTAL** water-cooled machine, *left*, and an air-cooled compressor, furnish air for starting gas-engine compressors



**TWO-STAGE** machine has 400-hp synchronous motor drive. It's installed 3000 ft below surface, 6000 ft from mine portal



**AUXILIARY COMPRESSOR** helps out in manufacturing plant, but one 300-, one 200-hp machine carries main air supply load



**AIR-COOLED** machine of 50 hp (one of several) pushes out air for continuous duty service for small manufacturing plant

By **S H GUTTING**, *Ingersoll-Rand Co*

# *air compressors*

in production. So plan on a small unit for week ends, holidays, etc. Examples: (1) dry-pipe sprinkler system (2) oil burners on furnaces which must be kept hot overnight or on week ends (3) air supply for tools used by maintenance crews over week ends.

**Type of compressor.** Capacity, number of units, pressure, type of drive, continuity of service, permanence of installation are factors to consider. You plant engineers should consult with compressor manufacturers for machine best suited to your needs. Compressor chosen will also depend on whether machine is for light- or heavy-duty work.

**Light-duty machine** is generally used for intermittent service. So this compressor is usually an automatic stop-start machine, running from 10 to 30 minutes at a time, not more than 3 to 4 hours daily. Light-duty machine is usually higher speed, of vertical or V type and may be air cooled.

**Heavy-duty compressor** is for running continuously at full load if needed. It must be dependable for many years. This machine usually runs at moderate speed, is water cooled. Machine costs more, but has more life built into it. It's also more economical from a power and upkeep standpoint.

This doesn't mean that a light-duty machine can't occasionally take over a heavy-duty job for a short time. But its economy won't be as great and mainte-

## Nine points to consider . . .

1 **Load factor**

2 **Work factor**

3 **Number machines needed**

4 **Type of compressor**

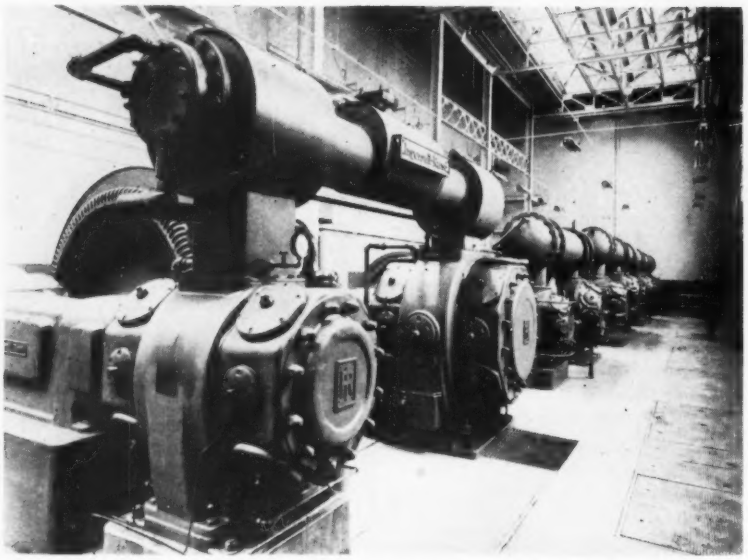
5 **Power sources**

6 **Synchronous-motor drive**

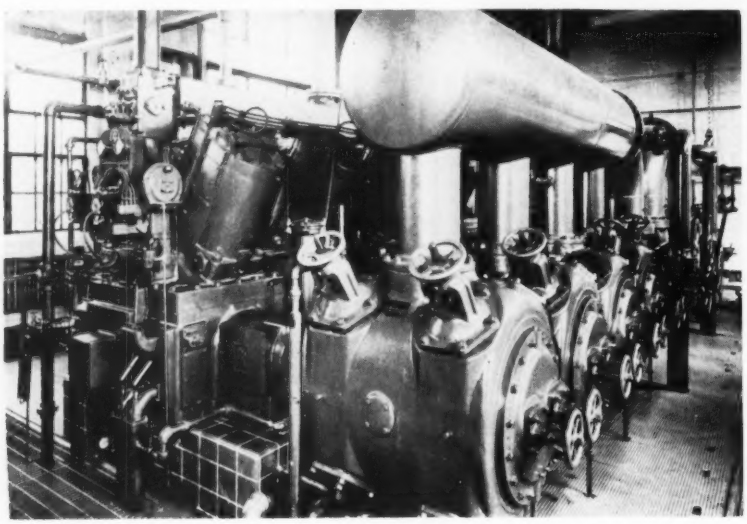
7 **Controls available**

8 **Compressor accessories**

9 **Distribution system**



**BATTERY OF FIVE** huge synchronous motor-driven machines supply air for a large factory. Older style machines, *background*, were installed back around 1928



**COMBINATION COMPRESSOR** and driving engine handle large quantity of coke and natural gas, at pressures between 5 and 25 psi. This is an efficient combination

nance cost is usually much greater.

Typical light-duty automatic start-and-stop machine comes in sizes to 20 bhp, is widely used for intermittent jobs.

Semi-heavy-duty machines, up to 200 hp, are usually air cooled. Running at higher speeds and electrically-driven, they may have a belted, coupled or built-in motor. Automatic start-and-stop or constant-speed control, or a combination of these, allow operation under most conditions. These units are often for standby or off-peak service. They allow shutdown of larger main compressors.

Beyond these types, heavy-duty water-cooled designs prevail. These range from 15 to 2000 hp per unit or larger. Single 100-psi air compressors have been built as large as 3000 bhp.

**Power sources.** Type of drive depends on economics of your situation, power sources and plant size. Electric motor, steam, gasoline, and gas or oil engine drives are used.

**Steam-driven compressors,** 15 hp and up, fit almost any boiler pressure. Steam units are very useful where exhaust steam is needed for process or plant heating.

**Synchronous-motor drive** solves many power-line headaches because motor increases power factor on line. These motors can be mounted directly on compressor shaft, same as a fly-wheel. You need no couplings, belts, etc. Motor's electrical efficiency is high.

Most commonly used main compressors are powered with synchronous motors, 50 hp and up. This design usually has two stages of air compression to reduce power needs over single-stage by 12 to 15%.

Motors with leading power-factors are easily applied. Motors of 80% power factor are standard. There are many ways to improve power factor for driving air compressors, but one of best is to use a synchronous motor. Analysis of power-factor problems may be complicated, but using a synchronous-motor-driven machine always helps.

**Engine-driven compressors** may save you money for some applications. Use a diesel-driven machine where electric power is from a diesel-driven generator. Here, prime mover is built into the compressor. You don't have to buy a steam or gas engine, or an electric motor, and then buy a compressor. Buy a steam-driven compressor, an internal-combustion-engine-driven compressor, or an electrically-driven machine. Compressor and its drive are engineered as a whole.

**Control of compressor** output is needed to (1) keep discharge pressure within limits (2) compress air as used. Range of 10 lb between loading and unloading points is close enough for normal use, but you can use a smaller range. Compressor maker can supply this, but don't ask for close-range regulation unless absolutely needed. The more often a regulator operates, the greater the wear and more frequent the load change on driver.

**Three general types** of controls depend on prime mover and compressor application. These include: (1) Automatic stop-and-start control. Unit runs steady at full load until pressure builds up to a set maximum. Then machine stops until pressure falls to a lower set value. Automatic start-and-stop units are always electric-motor driven. (2) Variable control, as on steam-driven units and on gas-engine units. You can usually vary speed with compressed air demand, with limit on minimum speed. This is probably most satisfactory of all controls, but it's not economical for electrically-driven units. (3) Constant-speed controls, such as come on electric units, are for constant-speed machines. Where automatic start-and-stop isn't

used, some form of output control is needed. It must vary the capacity while machine runs at full speed. Hence, term "constant-speed control." There are two types. "All-on, all-off" means that unit delivers full capacity or none. "Step" control means that capacity is varied in steps to give full, ¾, ½, ¼ and no load, or full, ½ and no load.

Controls come in many combinations for special uses. But don't complicate your operation with more controls than needed.

**Accessories.** Air filters, aftercoolers and air receivers are integral parts of a well-engineered system. Filter the air, since dust or foreign matter sucked into machine wears working parts rapidly. Particles form a coating on valves and cylinders. You can use several standard makes of air filters. Make sure filter is large enough to allow air to flow freely. Common filters are the oil-wetted and oil-bath types. For nonlubricated cylinders, use only dry-type filters.

Pipeline filters are used for air distribution lines. They keep scale or other foreign matter from harming tools and equipment.

Aftercooler should be used for most plants. It offers many advantages—is a must above 15 to 25 hp. Aftercooler removes most of the condensible oil and water in air, eliminates dangerous temperatures caused from faulty compressor operation or use of improper oils. It prevents excessive expansion and contraction strains on piping.

Air receiver is needed on any system to allow control to operate less often. Receiver also reduces wide and rapid variation in operating pressures. It collects moisture condensed in aftercooler but does not remove all of it. One big advantage: it reduces pulsations in discharge line. Also a steady flow takes place through piping beyond receiver. Pulsating flow in this piping always increases pressure drop. In some cases compressor may be overloaded. Build air receiver to conform to ASME *Code*.

**Installation planning.** Placing compressors in relation to all points of air use is important. Central plant for housing all compressors has advantages of unified operation and care, better supervision—usually cuts down labor cost. Also, no more compressors need run than are needed to maintain pressure. This gives you higher overall efficiency of entire plant.

At times you cannot have a central plant without excessive piping costs. So divide plant into two or more zones near load centers. Interconnect the piping so air may be distributed either way to meet peak load needs. Place plant as close as possible to larger load centers. This reduces piping costs, gives you higher pressure at tools and closer control of pressure.

*"There it is again."*

Allow enough room around each machine and auxiliaries for maintenance and safe operation. Well-lighted room, with suitable foundation, pays a handsome dividend.

Never place a compressor in a room where ventilation is poor. Don't place it in a corner. Have proper circulation of air around machine, especially if air cooled. Then compressor won't run hot; it will need less maintenance and have a longer life.

**Air intake.** On a unit of any size, say over 15 or 25 hp, it's usually best to take intake air from outdoors. Take from as cool a place as possible. Air must also be as clean as possible. Intake shouldn't be near steam exhaust or exhaust from ventilation fan. Place at least 10 feet above ground to cut down on wind-blown dust.

Cool intake air results in a big saving. Reduction of 11 F in average intake air means a reduction of 2% in power needed for air at air tool. So figure on this when planning; changes made later cost money.

**Distribution system.** Any drop in pressure between compressor and point of use is an uncoverable loss. Distribution system is, therefore, one of the most important elements of a compressed-air plant. Observe the following general rules in planning it:

(1) Size piping large enough so pressure drop between receiver and tool (including hose if used) won't exceed 10% of initial pressure. Provide for reasonable future growth. (2) Where possible, use a loop system around plant and within each shop and building. This gives a two-way distribution to point where air demand is greatest. (3) Long air lines should have liberal-sized receivers near far ends or at points of occasional heavy use. Many peak demands for compressed air are instantaneous or of short duration. Storage capacity near such points avoids excessive drop.

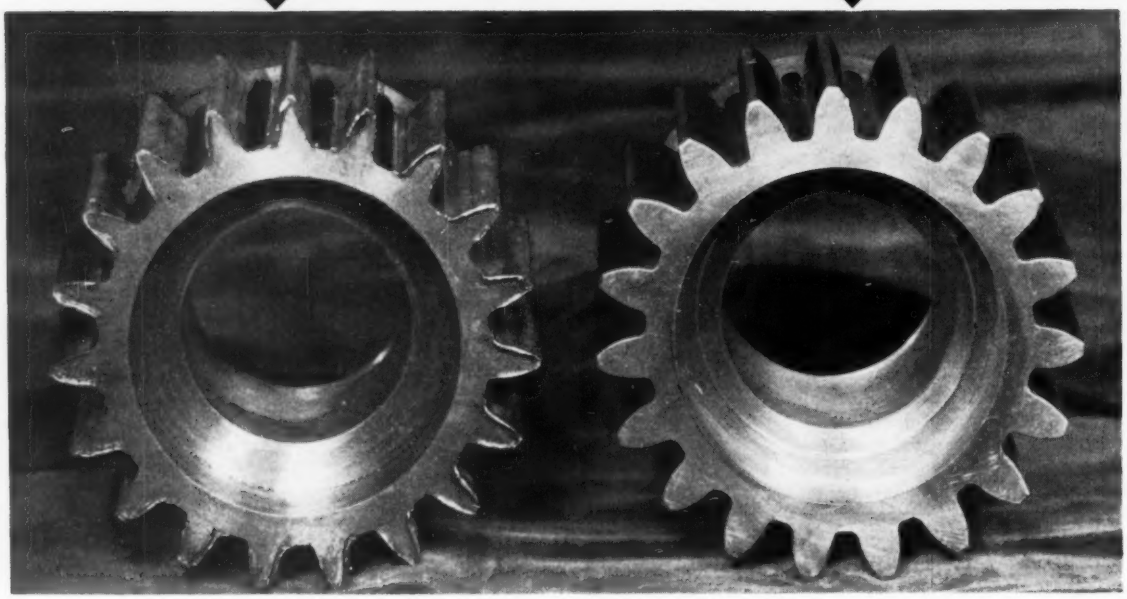
(4) Provide each header or main with outlets as close as possible to point of use. This permits shorter hose lengths, avoids large pressure drops through hose. Always locate outlets at top of pipeline to prevent condensed moisture carryover to tool. (5) Slope all piping toward a drop leg or moisture trap. Then condensed moisture is removed to prevent carrying into air tools or air-operated devices. Always slope air lines away from compressor to prevent condensate from draining back into compressor cylinder.

Oversized piping is usually a good investment. Additional cost is small since major expense is for installation labor. Larger-sized piping also allows for future expansion.

Consider all these factors carefully. Some smart planning now will bring you years of trouble-free performance.

**This gear ran one week with manual lubrication**

**This one, three years with centralized lubrication**



**Plagued by burned-out bearings, gear-tooth failures? You may have...**

# *A case for centralized lubrication*

► YEARS BACK men who operated machines were often skilled mechanics who lubricated and maintained their own units. They may not have been lubrication experts but they did have a single-minded interest in keeping them going.

**New ways.** As industry became larger and more specialized, maintenance tended to separate from operation. And unfortunately lubrication too often drifted off into an independent chore that got little real attention from anybody. "Oiling" became a low-skill low-pay job with little incentive. Today, lubrication engineers, relative newcomers to the professional field, are stepping into the picture. In many cases they are making lubrication an organized, scientific plant function. However, while this is happening in a growing number of plants there are still others who fail to see the short- and long-range benefit of proper lubrication. Let's take centralized lubrication as an example.

Plant engineers and maintenance supervisors in too many cases are cold to centralized lubrication. I believe that this is partially because they know that a central system is but a mechanical means to doing what is now being done manually . . . and they are not sure just what this is. Actually it's this lack of knowledge of what is going on that proves to be one of the major stumbling blocks.

By **JAMES FARRY**, *Alemite Company, Buffalo, N. Y.*

To convert ordinary expressions of lubricant quantities, like a drop, squirt or shot to something as precise as 0.005 of an ounce or cubic inch drives many plant engineers into a shell of procrastination. Probably the thinking, or lack of thinking here, is that while confession is good for the soul it isn't always good for keeping your job.

**Plant lubrication** may be considered in a parallel vein with plant protection. When lubrication was a matter of one man lubricating one machine, an oil can and a grease gun and receptacles for oil and grease on the machine were adequate. We might say they were adequate just as a bucket of sand and a hand fire extinguisher were adequate in the small simple plant of yesteryear.

However when fire protection came to be regarded as a plant-wide concern, the decimal point was moved and a fire chief was appointed. He was soon armed with sprinkler systems, water tanks, alarm systems, sometimes a fire engine and crew and specially trained men. In short, everything needed to give him control in all areas where he could not be physically present.

He wasn't expected to just multiply the sand bucket and hand-squirt guns to get his job done. And he was never asked to amortize these items by proving how many fires he could extinguish in a given period. One way to look at it is to move the lubrication decimal point over and seek the prototype of the sprinkler system, the well-equipped

fire engine, the sure supply of water, the alarms and, above all, a man of stature to control them. But centralized thinking must come before centralized lubrication.

Very few conceptions of machine parts include paint and lubricants, yet the lubricants must be changed infinitely more often than all other parts combined. If this fact were properly established in the modern industrial plant, there would be an altogether different approach to lubrication. Many men who must be concerned with overall plant operation and co-ordination would be concerned with lubrication problems. In many cases I believe they would turn to centralized systems to solve the problems.

If management really knew how often lubricants must be replaced, the present methods and costs of doing it and that it is rarely done completely and on schedule, the lubrication engineer would soon get a long overdue boost in rank and backing, and lubrication would have the place it merits in plant protection.

**The manufacturers** of centralized lubrication equipment have to take some of the blame for the lack of understanding about this equipment. In many cases they have disguised their product by fancy names and weird stories of isolated accomplishments so it is not recognized for the simple commodity that it really is. In my opinion, if the makers of windshield wipers were always to associate them with Cadillacs or fire engines, it might take some time for the users of Fords and Chevrolets to realize the value for them, too.

Look also to the literature from equipment builders who glibly advise applying lubricant daily, twice daily, monthly, or as often as required. This type of advice given to a plant with thousands of machines and limited manpower can quickly lead to no lubrication at all.

Many men seem to be deceived by the presence of oil cups, drip feeds and grease fittings. They think that all that is needed is to associate the proper products with the proper machines. This only insures that in case of disaster everyone will know what should have been done. Every time I pass a machine with 15 to 25 oil cups I am inclined to reverently remove my hat. The number of empty cups tell me how quickly that machine's life is ebbing away.

In fields where progress has been made, advancements may fail to include some of the more desirable aspects of earlier stages. For example, in transportation the automobile does not have the horse's ability to learn the stops and make them without direction, or to carefully avoid an object on the ground. Likewise, the airplane can't drop you off in the center of town as the train or bus can, and you miss many of the sights as you fly.

But in each case the advantages in taking the step ahead are so great that the former extra benefits are either sacrificed, achieved in some other way, or simply forgotten. So it is with the plant oiler. He can both lubricate machinery and serve as a trouble spotter while making his rounds. Actually, I see him as a second cousin of the old lamplighter who could both light the lamps and fix or report broken ones. Yet few cities today would hire lamplighters in preference to turning on all the street lights simultaneously and automatically as darkness approaches.

Like the lamplighter, the oiler is subject to many delays and interruptions; there are seldom enough oilers around the plant; the oiler can only be at one machine at a time. Everything beyond must wait, but the forces that demand lubrication do not wait for him to arrive at the scene.

## Conditions demanding lubrication don't wait for the oiler's rounds

**Early steps** in centralized lubrication were concerned with the single machine. Aim: To permit certain lubrication while the machine is running, insure the proper lubricant, measure it, keep the operator out of dangerous locations when oiling is necessary. There was no great economy of labor because the man was bound to the machine anyway.

Too often plants see the wisdom in centralized lubrication for individual machines, but have difficulty justifying an overall centralized system. If you consider that the machines are already connected together through the electrical system and very often by water and air lines, it seems just as fundamentally sound to connect them with lubrication lines.

If a complete department or a whole plant can be treated as a unit . . . electrically or mechanically, from the point of view of other utilities . . . it certainly should be so treated from the angle of lubrication.

**Adequate controls** are available to cut individual machines in and out of the lube system as required, and a centralized pump can often do the job at lower initial cost than individual pumps for each machine. A few feet of open floor space between machines should not deceive the plant engineer into thinking he has 100 small problems, demanding 100 solutions, when he really has one larger problem capable of a single solution.

For instance, in Remington Rand's Tonawanda, N. Y. plant, a centralized lubrication system installed ten years ago furnishes grease to about 100 punch presses.

One machine in particular, a high combination punch press and press brake, formerly took four hours to lubricate completely. Only the integrity of the worker determined whether all the bearings were lubricated. Hooking up to the centralized system cut this time to less than one minute.

The flywheel bearing on this press had been replaced at least every three months at a cost of about $300, not including machine downtime. After it was tied into the centralized lube system, this same bearing lasted more than two years.

On the overall picture, the centralized lubrication system allows Remington Rand to run 2nd and 3rd shifts without any maintenance; and machines are adequately lubricated. The oiler and greaser status has been eliminated, as there is not enough work to keep them busy.

All mechanical machines are now lubricated by millwright "A" men, and all electric motors by electrician "A's." Plant engineer George Wescott has found that the "A" millwrights do not overlubricate, and quickly see if a part is starting to wear from other causes. All fittings for hand lubrication are the pressure relief type, so men cannot break the seals by overlubricating.

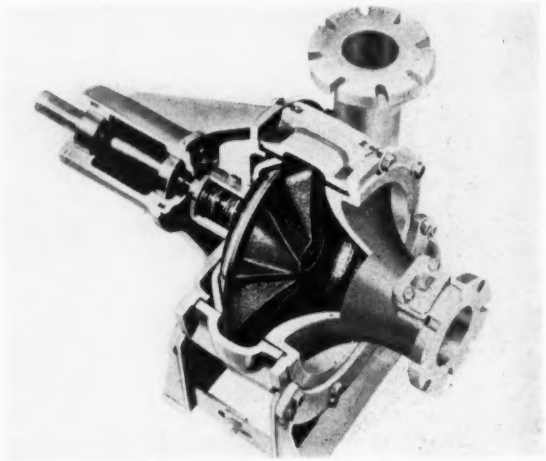
Since electricians have been responsible for lubricating the motors, the number of burned out bearings has been greatly reduced. Ten years ago an average of one motor burned out every day. Now a burned out motor bearing is unusual. Wescott found that overlubrication by oilers who were interested only in saturating the bearings, and not too particular what lubricant they used, had caused the trouble.

**OPERATORS' NOTEBOOK 111**

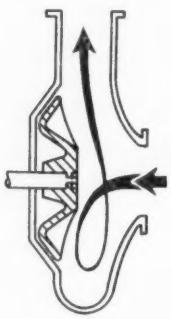
# This torque-flow solids

## Here's why pump lifts solids

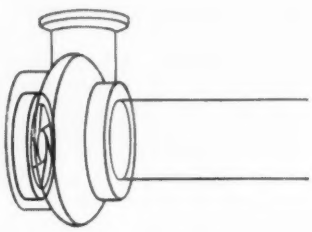
**BALING WIRE,** rags, gloves and garden variety trash shown is an everyday diet for this unusual solids pump



**LOCATING** impeller away from main flow path insures clear passage of any liquid-solids combination that passes through



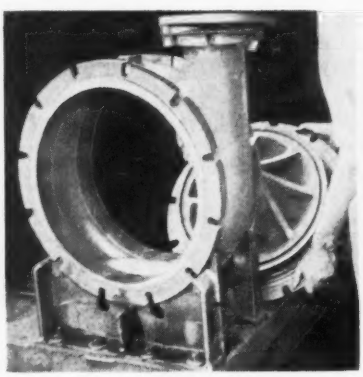
Rotating fluid forms carrying medium (induced by impeller)



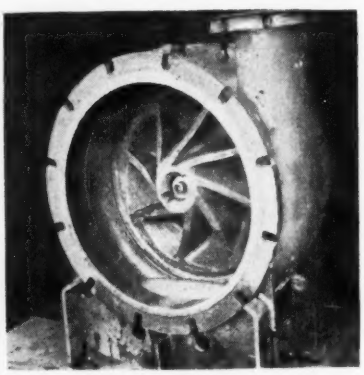
Torque developing impeller is out of solids flow, leaves open passage for free flow

## How to keep it working

Solids pumps often have to be opened in a hurry, even when the impeller is recessed and passage through pump is open, as in this unit. Photos show how both ends of casing can be opened, impeller removed and reassembled in a minimum of time. You can open pump from either end, completely or partially, without disturbing the piping. Shaft seals come in one of three types: grease, water-lubricated packing box or mechanical seal. Adjust discharge direction by turning pump casing.



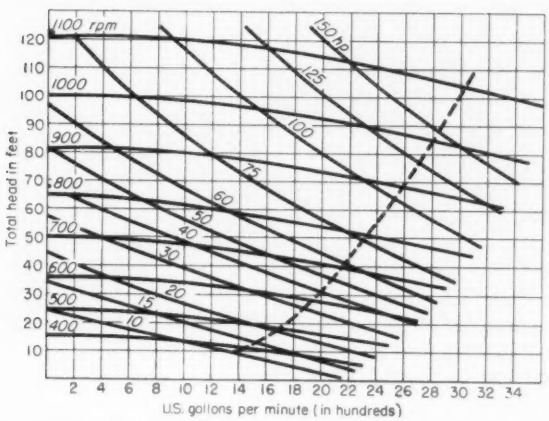
1 With the pump casing on stand, place recessed impeller into position



2 Hold the impeller section against the casing and bolt it into place

# pump picks up almost everything

BY STEVE ELONKA, *Associate Editor*



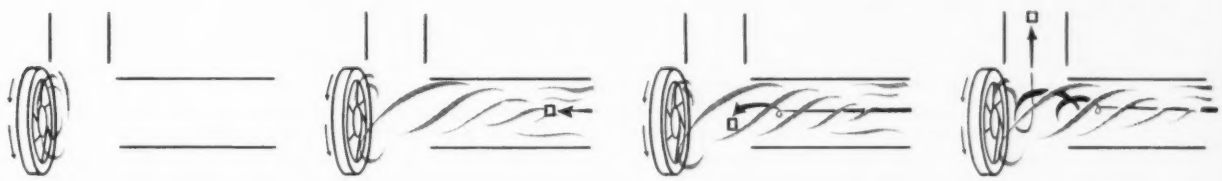

**RANGE** of pump operations is shown by curves at left of dotted line. This chart is based on tests with water at 85F

► "WHAT MAKES IT PUMP?" engineers ask when peeking inside. It not only pumps, but picks up everything from baling wire to rags. Pump action is produced much as a torque converter transmits power from engine to shaft. Action is similar to a whirlpool or hurricane where materials swirl together and are carried away in spout.

How about suction lift? Pump gets to within 5% of theoretical maximum lift, or above 29 ft. Big difference in this end-suction pump is its open housing. Action of recessed impeller induces a swirling, sucking motion in the incoming feed. Thus solids are carried by the liquid with minimum contact with pump impeller.

Main reason large pieces get through and do little harm to impeller is the open chamber and cushioning effect of carried solids. No critical adjustments are needed to maintain working efficiency. There are no wearing rings, pump maintains rated capacity without clearance adjustment. It handles fibers, rags, ores, coal, abrasives, etc.

Curve, left, is for approximate capacities. Make needed corrections for specific gravity, viscosity and temperatures. —*Courtesy, Western Machinery Co, San Francisco, Calif.*



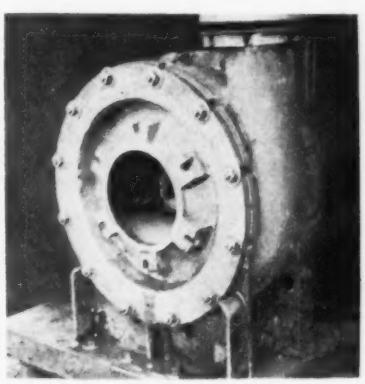
Impeller develops a swirling vortex of incoming mass. The solids seldom touch impeller

Vortex extends into suction; draws particles into moving stream; like a waterspout

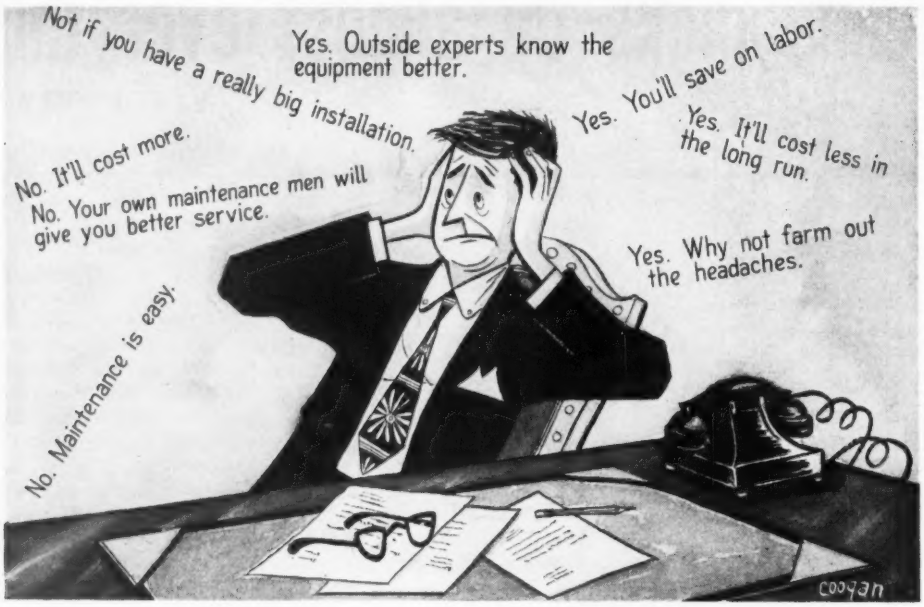
Solids particles swirl into the fast moving vortex within pump housing as shown

Most particles are discharged within one revolution by the centrifugal of vortex action

**3** Feed flange is now ready to place against suction end of the pump. With the rear end already bolted, these two ends allow you to open the pump in a hurry



**4** Housing is closed with impeller flange and feed flange, ready for the piping


Not if you have a really big installation.
Yes. Outside experts know the equipment better.
Yes. You'll save on labor.
Yes. It'll cost less in the long run.
No. It'll cost more.
No. Your own maintenance men will give you better service.
Yes. Why not farm out the headaches.
No. Maintenance is easy.
COGAN

**Should you invest in an air-conditioning service contract?**

# *Here's what service men, users say about outside service contracts*

► In Power, May 1957, pp 124-126, L D Smith, Supervisor, Maintenance Contracts, York Division, Borg-Warner Corp, presented an article on the value of air-conditioning service contracts. The gist of his thinking appears at top of facing page. We've since received several interesting and significant comments from readers on this subject. Here's what they have to say:

## Smith overestimates advantages

Mr Smith presents good arguments for the necessity of regular inspection of air-conditioning equipment. But he overestimates the advantages of an air-conditioning service contract for the average plant. His examples of breakdowns prove the value *and necessity* of preventive maintenance. They *don't* prove that preventive maintenance is best served by an outside service contractor.

True, there *is* a shortage of qualified technical maintenance men in many plants. But the average air-conditioning system isn't so complex that unusually skilled mechanics are needed.

Also, the shortage of trained men will affect the outside service contractor as much as the plant. In fact, the plant may be able to offer its maintenance men more benefits than the service contract operator.

I agree that calling in an outside service contractor after the breakdown has occurred runs counter to the idea of preventive maintenance. But it doesn't follow that "the outside contractor has no personal or financial interest in the installation or the business itself." If the responsible plant manager deals only with reliable firms, the contractor will do the best job he can in order to establish repeat business.

The attention which mechanical equipment gets will depend on the type of installation. Generally, most manufacturing plants have maintenance crews who can inspect the air-conditioning system regularly. Such plants rarely require an outside service contract. To a lesser degree, this holds for large office buildings, hospitals, hotels and large department stores. The situation may be different in apartment buildings, restaurants and small stores.

Mr Smith's example of the 18-yr old air-conditioning equipment which was in such good shape that it could be used in another store is interesting—but again it proves only the value of preventive maintenance, not the need for an outside service contract.

W O Huebner, *Anemostat Corp of America*

## Big problem is getting skilled men

If the installation is big enough, there's no absolute need for a maintenance contract. Operating engineers

## The gist of L D Smith's article on service contracts

If you decide to do your own servicing, you run into several major problems: (1) How to train skilled maintenance men. (2) How to keep these men abreast of the latest maintenance practices. (3) How to make the most effective use of a skilled mechanic's time when only part of that time is required for air-conditioning maintenance.

Size and complexity of your installation have a great deal to do with whether it'll pay you to hire your own maintenance men. But going by size alone can be misleading.

One possible solution: Call in an outside service contractor as troubles arise. But if you don't actually have a service contract with him, you run the risk of future breakdown, high time and material charges. And you don't get a planned preventive-maintenance program.

The alternative to hiring your own men or calling in a service organization as needed, is retaining an outside service firm to carry out a maintenance program. You buy these programs as a contract.

The most complete type of maintenance contract offers not only inspection, oiling and adjustment of the machinery, but also calls for furnishing and installing repair parts, oil, refrigerant, supplies and emergency service needed to keep the plant in top condition.

An alternate form of preventive-maintenance contract covers inspection, adjustment and oiling of machinery, together with furnishing some minor supplies.

Significant trend: As specialization increases and systems become more complex, more owners will be using maintenance contracts. These systems range from the smallest packaged units to the biggest installations.

are expected to maintain heating plants, electrical distribution, etc. Why can't this same principle be applied to air-conditioning systems?

Big problem is finding the right man to handle the maintenance. He must understand wiring, controls, pneumatics, refrigeration, etc. He's really out of the category of the ordinary maintenance man.

On a large installation the owner gets more for his money by hiring his own men. He can still call in a service organization for major breakdowns. In New York City the code requires a licensed operating engineer for equipment over 50 tons. This man could also perform routine maintenance—oiling, cleaning strainers, checking Freon leaks, making temperature adjustments. Similar code restrictions are found throughout the country.

I'm not in full agreement with Smith's comments on calling in a service contractor as troubles arise. First, any reliable service organization has an interest in your installation whether it's under contract or not. But contracted customers naturally get first preference in answering calls. Also, a reputable contractor stands behind the work he performs. So you do, in effect, get a guarantee.

I agree that time and material charges would run high if you had no regular maintenance man on the job. On the other hand, if you had your own *good* man on the job, parts failure would be rare. In general, manpower is more expensive than parts.

For large installations a full-time qualified maintenance man *would* set up a program.

The biggest opportunity for user savings through maintenance contracts is in units under 50 tons. The user really contracts for a manpower pool, complete parts coverage, inspections, etc. Such conditions fit the majority of commercial institutions.

J T Ledwell, *S J O'Brien Sales Corp*

## Service contracts well worth their cost

I feel that Smith makes some valid points in his discussion of service contracts for air-conditioning systems. Most users know little about their equipment and would prefer to concentrate their efforts on their main line of business rather than spend time hiring and training maintenance specialists.

In contrast, the service organization (especially if it's schooled in the user's brand of equipment) knows the system thoroughly. The contractor can afford to hire and train the specialists demanded by today's complex air-conditioning systems. In fact, many contractors hold regular classes for their men, and they may specialize in one manufacturer's line of air conditioning. I don't see how the user can duplicate this.

A maintenance contract that covers only inspection, adjustment and oiling of machinery along with furnishing minor supplies is not enough. These functions could be handled by an operator. It's when you're really in trouble that you want expert service.

Smith mentions the possibility of calling in a service contractor as troubles arise. This can be more costly in the long run than the service contract. Here's why: If you're getting a regular preventive maintenance program as part of your contract, it's highly unlikely that major troubles will crop up.

If you wait until major troubles arise before calling in the experts, chances are you'll be faced with a hefty bill for parts and labor. And, even worse, your equipment will probably be out of service when you need it most because the troubles are more likely to show when the units are pulling greatest load.

All things considered, the outside air-conditioning service contract looks like a bargain to me.

Don Kelland, *Consulting Engineer*

Plant Electrical Fact File

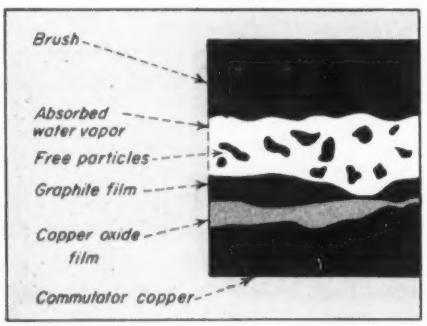
NO. 17: COMMUTATORS

# 7 TIPS on commutator care

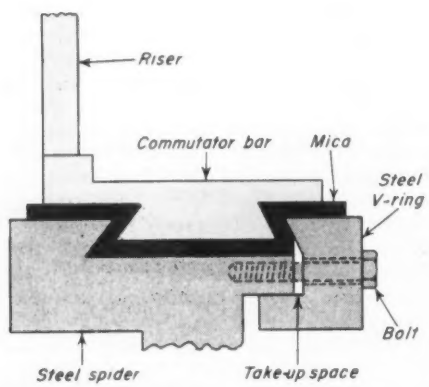
By NORMAN PEACH, *Assistant Editor*

► COMMUTATORS are the hearts of dc motors and generators and consequently need good care. In *Fact File No. 7*, Oct 1956, we talked about how to select and apply brushes for best performance. Now let's take a look at what can be done to keep the commutator itself in tip-top running condition. Serious trouble requiring repairs and turning or grinding can usually be avoided if commutator is kept clean, slots are kept free from dirt and brushes are properly applied. Current density in brushes is important too. Overloading or *underloading* has adverse effect on commutation. Underloading prevents good film.

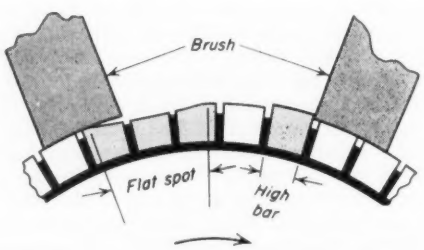
*Prepared with assistance of National Carbon Company*



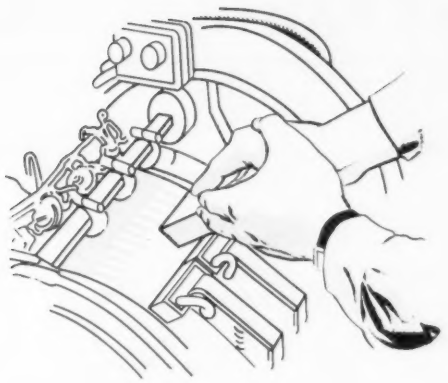

**1** **FILM** on commutator is essential for good commutation. It provides conducting and lubricating layer between brush and copper bars, keeps arcing and wear to minimum. Water vapor comes from surrounding air. If air is completely dry or contaminated, the commutator will be rough.

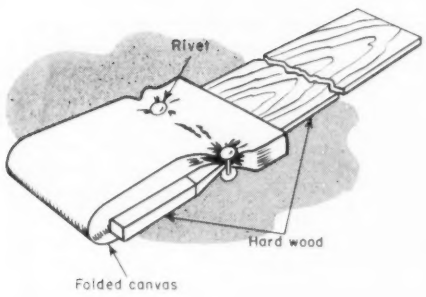



**2** **MECHANICAL TROUBLES** may be at bottom of bad commutation. Commutator is made up of many small pieces and a variety of materials. Successive temperature changes, vibration, etc can cause loosening, uneven stresses. If you suspect mechanical trouble, tighten ring evenly.



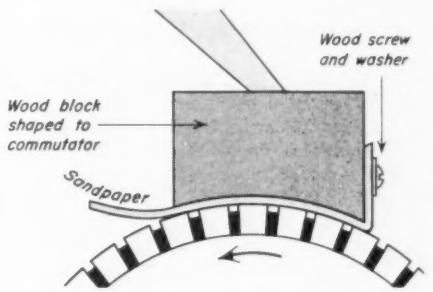

**3** **HIGH BARS AND FLAT SPOTS** can result from mechanical trouble or local electrical trouble, such as overheating from short in mica, excessive sparking due to high mica. Tightening commutator too much can cause bars to bulge. If commutator is out of round, turn or grind it true.



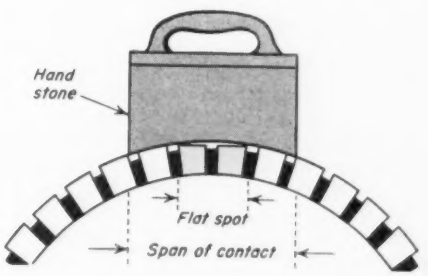


**4** **CLEAN** commutator when necessary without destroying film. One of easiest and best ways is to use homemade canvas wiper. Fold several layers of clean, hard 6 to 8 oz canvas over flexible wooden stick, rivet in place. Press canvas against rotating commutator, move parallel to the bars.

**5** **CLEANER BLOCK** resembles oversized eraser. It's made to rub off deposits of dirt and grease when you hold it against rotating commutator. It does not tend to plug slots. Cleaning commutator, of course, always includes careful inspection of slots. Oil or dust in slots is trouble source.

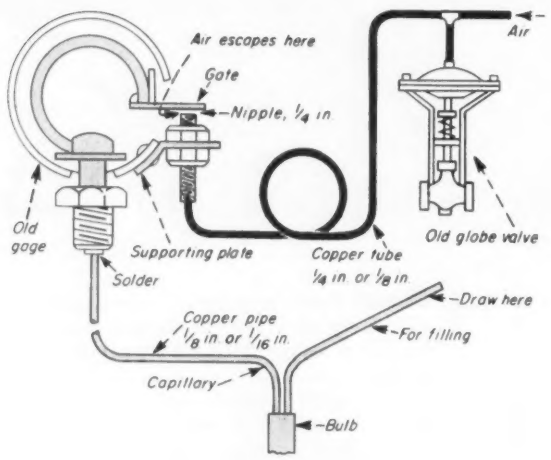



**6** **SANDPAPER,** attached to wooden block carefully shaped to commutator contour, will smooth surface, remove tenacious deposits and burrs. Shift block slowly side to side. Use sandpaper only when needed; it removes film, can scratch surface, may aggravate flat spots. Never use emery.




**7** **STONE** commutator to remove roughness or burrs that are too much for sandpaper. Stone will often remove small flat spots or high bars if not too serious. Shape stone to curvature of commutator with contact span wider than broadest flat spot. Apply when running, move side to side.

# Smart PRACTICAL IDEAS to help you speed up your




## This homemade modulating thermostat saves $$$

Almost every industrial plant using steam for heating or process needs modulating thermostatic regulators. Here in the Argentine we have import regulations, so we often have to develop our own instruments.

Thermostatic device, above, works smoothly in water or other heating circuit with 3- to 4-F tolerance. We have dozens of them working in our textile mill. All you need is compressed air from 30 to 70 psi, an old pressure gage reading 0 to 15 psi or 0 to 30 psi, a few feet of 1/16- or ⅛-in. copper tube as a capillary tube and a 4- to 6-in. length of ⅜- or ½-in. copper or brass pipe.

You also need a diaphragm and a globe valve. In assembling the regulator you can use any globe valve provided the size is right. Expanding liquid for your bulb is petroleum ether, which is volatile and harmless. You must use your lungs as a vacuum pump to fill the bulb and capillary tube. Liquid may be mentholated alcohol.

I use a pressure gage because it transmits the expansion movement to the pointer. Be sure to check gage for accuracy before using. Modify case of gage as shown. Rivet, bolt or weld a small supporting plate to the case, sketch. Plate should sustain a piece of ⅛ or ¼ in. nipple with two nuts to adjust its vertical position. File end of this nipple and reduce the air escape-hole to about 1/16 in. or less.

At end of expansion element attach a small piece of No. 18 sheet iron or brass as a gate. This gate closes or opens the air escape hole in nipple under gate as bourdon element moves.

Silver-solder two capillary tubes into open end of pipe to act as bulb. Long copper tube to gage is capillary and short tube is for filling.

After welding or soldering, introduce end of long capillary into ¼-pint bottle of petroleum ether. Then suck at end of short tube until ether starts entering your mouth. Don't worry about bad taste. Spit it out and insert filling end into the gage at nipple under the gage. Then solder it perfectly. Some liquid will drip, but this is from expansion while heating. You can prevent dripping by cooling the bulb with very cold water or ice during this operation.

After filled capillary tube is soldered, flatten the end of filling tube and quickly solder tight as it must be hermetically sealed. Immerse bulb in hot water at its future working temperature. Adjust nipple so it is close to gate on gage. At same time, check all soldering for leaks.

Before making changes on the pressure gage, decide if the diaphragm valve should close or open with the pressure. Position of support plate and nipple can be easily fixed in a reversed way. That will make it close or open the air when working temperature is reached.

W BEREZECKI, *Buenos Aires, Arg.*

EDITOR'S NOTE: I know that few of us have to make our instruments. But I've seen the time aboard ship where we had to rebuild instruments in an emergency.

## Stop those losses . . .

In 1956 the three most expensive losses in industry were from explosions. One followed the release and ignition of flammable vapors from a varnish-making process. The second occurred at a brewery, when anhydrous ammonia refrigerant escaped through a cracked cast-iron strainer cap and became ignited in some unknown way. Third was at a large ship's pier. All of these come under jurisdiction of you plant, utilities or maintenance engineers in some way. Here are a number of losses for 1956 reported by one insurance firm:

| *Cause* | *No. of claims* |
|---|---|
| Fire | 4311 |
| Windstorm | 2243 |
| Use and occupancy | 655 |
| Riot, vandalism, etc | 602 |
| Lightning | 458 |
| Leakage | 512 |
| Vehicle | 276 |
| Explosion | 267 |
| Earthquake | 1 |

You can put this information to work as a preventive measure by checking your plant and guarding against possible trouble. Use the incidence method. Because there were more fires than anything else, give most attention to fire hazards. Next come windstorm. If a violent wind comes along, what might let go first? Well, make sure it's secure. You know, "an ounce of prevention . . ."—EDITOR.

## Watch for these . . .

two causes of most all boiler explosions: (1) rapidly adding large amounts of water to an overheated boiler (2) safety controls failing from negligence.

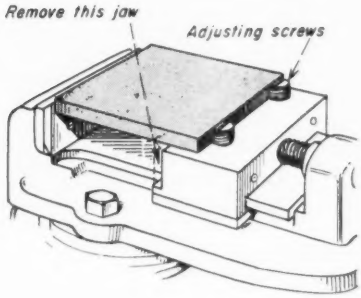
## I don't agree

In POWER, April, p 131, D V Haraway tells how he got caught without matches to relight his boiler while on watch. I have been in a number of plants—marine, naval and stationary—and I have yet to see a plant that didn't have a coffee pot. I would have gotten a light off the hot plate that operates No. 5 boiler (the coffee pot).

L M MARTINEZ, *Jamaica, N. Y.*

# operation and maintenance jobs

STEVE ELONKA, *Associate Editor*




## Same vise, more capacity

Your small machine vise can hold longer pieces, sketch. Our 3-in. vise now holds 6-in. square plates for taking light skimming cuts over top surface in milling machine.

One edge of work bears on fixed vise jaw, other on one or two flattened screws fitted into the sliding jaw. Most modern machine vises are faced on upper surface of sliding jaw and parallel with the vise-base surface. That gives an accurate locating surface for work. Remove false or hardened jaw on sliding part to leave recess empty for flat work as shown above.

One screw with flattened face will conform to work if not perfectly parallel throughout its width. You can raise or lower screw in tapped hole. If one edge of work is curved, two of these screws spaced apart will conform with work profile, giving a 3-point grip. Third point is fixed vise jaw. You can also grip a disk with two screws in the sliding jaw as shown. above.

C T BOWER, *London, England*

## What would you have done?

In the sleepy hours of 3 am, the night watch rattled my storm sash. The shaft boss sent word up from the 1400-ft station. Trouble was the shaft dewatering pump wouldn't work after being reinstalled, following a blasting operation. The boss was an old-timer, so I knew he needed help or he wouldn't have sent me an SOS.

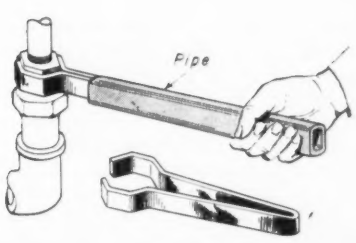
Arriving on the scene, I found a group of disgusted miners. They were losing money fast, as the water continued to rise and prevent them from sinking their shaft. A rapid-fire question-and-answer period didn't help. Seemed everything had been done according to routine in putting that pump together.

But why didn't that piston pump lift water? Although half asleep, I started a close, detailed inspection. I checked the suction pipe and hose for possible holes caused by ricocheting blast rock. Only a few tiny holes showed up. They were quickly plugged. I climbed out of the shaft ahead of the rising water and sat down on a tool box to smoke and collect my thoughts. While asking about the valve spring and rod packing, my eyes lit on the gasket trimmings on the pump room floor. Something didn't seem to be there.

When I asked the gasket whittler where he stored the inner solid section of the gasket material, John, the shaft boss jumped to his feet and exclaimed in his Finnish dialect, "Meester Mechanic, you find da trooble. Alex, he no cut out meedle of gasket." That was it. Three hours of lost production because of a blind gasket. What would *you* have done?

P C ZIEMKE, *Oak Ridge, Tenn.*

## Straddle box-wrench is used for close quarters




Do you have to work in tight places with tools? Close quarters are from poor layout, or from adding piping, fittings, etc too near to other equipment.

Well, you can overcome some of these problems by special tools, sketch. We use this wrench on union joints located close to a wall. You can make one in your plant. Use flat or bar stock and a piece of pipe. Tool straddles the flats and acts like a ratchet wrench. After placing over the hex, just lift up or down to give six-point operation.

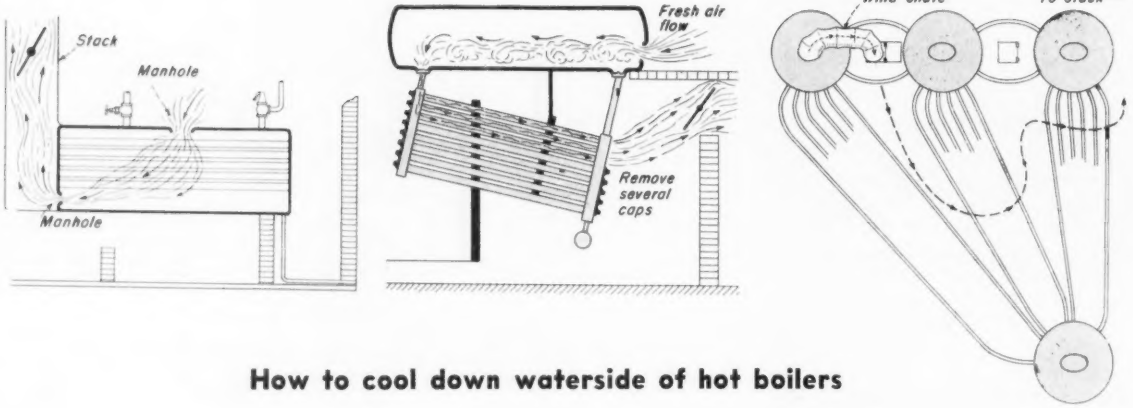
C H WILLEY, *Concord, N. H.*

## Do you know . . .

that motors driving fans can, and do, fail if they have no reserve capacity? Motor for induced-draft fan burned up recently because density of very cold air in stack at start-up was so much greater than air at normal temperature that its increased weight overloaded fan motor. This in spite of motor normally operating below nameplate raising. So, size your fan motors correctly. — *Courtesy, Hartford Steam Boiler Inspection and Insurance Co.*

*Turn page for more Practical Ideas* ►

Begins on page 120




## How to cool down waterside of hot boilers

Entering hot boilers isn't fun. It sometimes helps to change air flow so heated stack draws fresh air through the boiler. But best result isn't always with most accesses open.

**Hrt boiler.** Let's say you have to enter an hrt boiler six hours after it's cut out. This always happens in a creamery where milk is received seven days a week. Steam is needed until all equipment is washed, usually at 4 or 5 pm. To get in, haul fire and open drafts to cool refractory; then haul ashes and wet down. While not good practice, pumping cold water in and blowing down may get steam off within an hour. Do this until you can hold your hand against blowpipe. Drop in top manhole cover and start spraying water inside of shell from the outside.

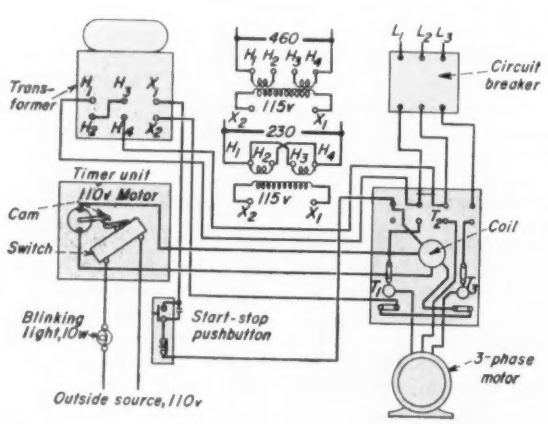
Keep your head to one side to avoid cloud of vapor from manhole. Refractories lose some heat after a few hours, but boiler shell remains hot. Continue to spray and lower water in boiler. Drop front manhole cover and remove it. Now close front uptake doors. Some heat will be drawn from furnace and combustion chamber through tubes, going up stack, first sketch.

At same time, fresh air is drawn into top manhole, goes down and out front manhole, picking up vapor on way. Continue spraying. When vapor stops, spray for a few more minutes. Top of tubes under manhole will dry quickly.

**Longitudinal drum boilers.** Knock out four or five handhole plates in rear header under drum, second sketch. Lay burlap over down-comer tubes in rear saddle. Close ashpit, cleanout and firing doors. Circulation will be through manholes, length of drums, down through front nipples to front headers, back through tubes and then uptake or smoke trunk.

**Bent-tube boilers.** These are tough to ventilate through the drums. You may make a wind chute of canvas and hoops, fit over a manhole. Place other end at a pass cleanout door, third sketch. Bent-tube boilers have to be well-cooled before you work inside them.

F L GILMOR, *Albany, N. Y.*




## This alarm tells us when ash crusher stops

We had to put an alarm on our ash crusher to let our auxiliary engineer know when it stopped. When an extra-large hard clinker stopped the grinder and the auxiliary didn't stop pulling ashes, the grinder and trough way filled with ash. That made cleaning a tough job as ash crusher is in an outdoor pit. We hesitated using a mechanical or electrical device because of moisture and dirt problems.

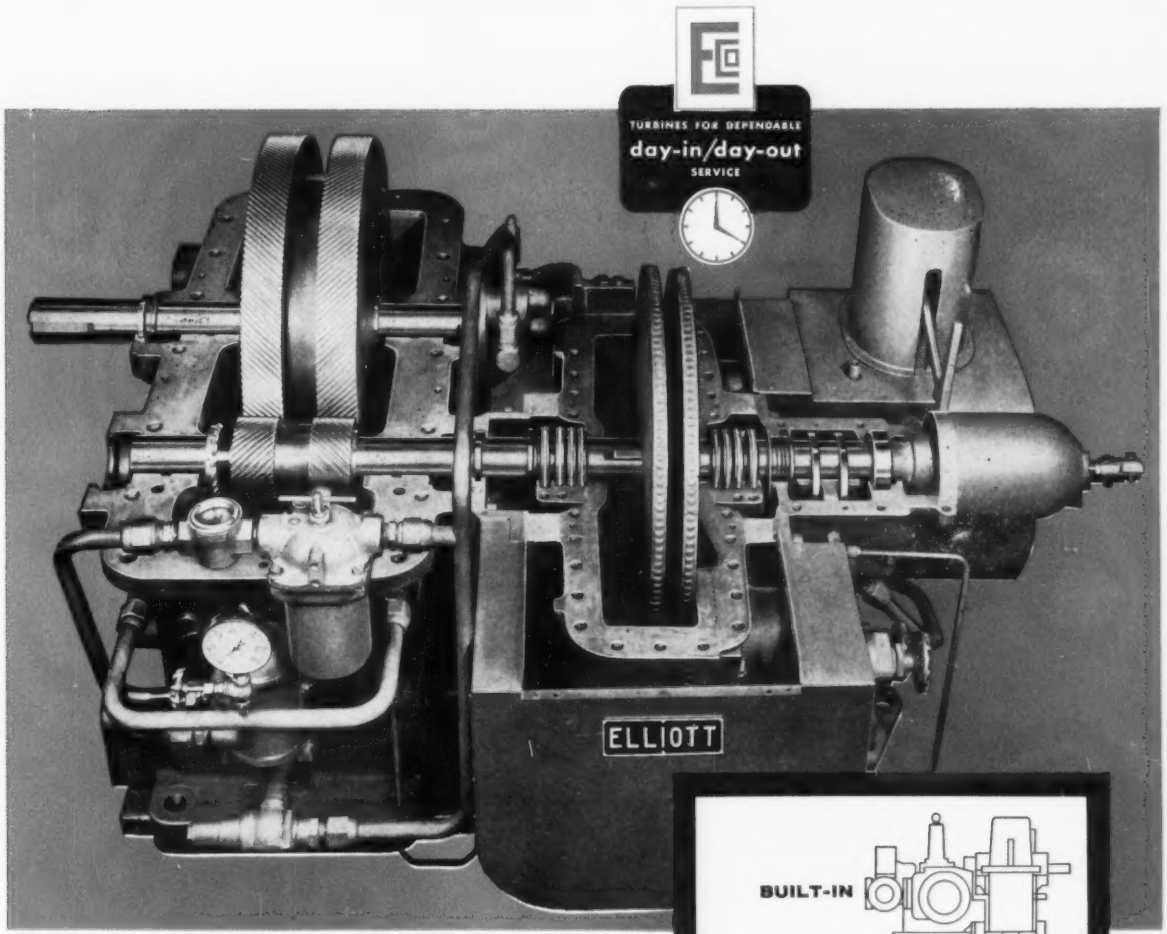
After searching for a year, we spotted a recycling timer advertised in POWER. We bought it for $10 and hooked it up, sketch, left.

When contactor on crusher closes, it energizes the holding coil. The clock motor on timer is hooked across the holding coil to start operating immediately. This blinks the two 10-watt bulbs at a rate of 50 cycles per minute. We use two bulbs so if one burns out, other will still give an indication. These lights are mounted at ashpit doors in front of the man pulling ashes.

We have not had an accident from this cause since making this change.

C GILBERT, *Chamois, Mo.*

*Turn page for more Practical Ideas* ▶




# ELLIOTT *Geared* TURBINES

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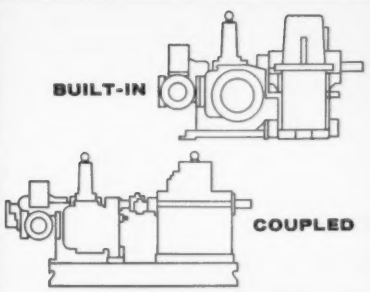
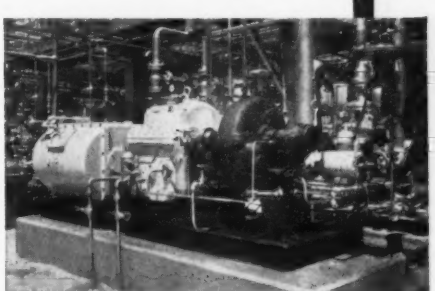
In operating many low-speed machines—such as fans, pumps, compressors and lineshafts—maximum overall efficiency is achieved by employing high-speed steam turbines which drive the machines through reduction gearing. Elliott has long been a leader in the design and application of geared turbines, built-in or coupled, which drive lower-speed machines without sacrificing the compact size or high operating efficiency of the turbine.

Design features of the built-in type, seen in the cutaway above, include: compact, rugged turbine and gear case, one-piece high-speed shaft, double-helical gear and pinion, dynamically balanced gears, liner-type bearings. These and other advantages assure sustained operating efficiency over the years. For details, ask your local Elliott field engineer for Bulletin H-19, or write Elliott Company, Steam Turbine Department, Jeannette, Pa.



Here a compressor in a petro-chemical plant is driven through separate Elliott reduction gearing by a YR turbine. In this type, the gears are coupled to the turbine by flexible couplings.

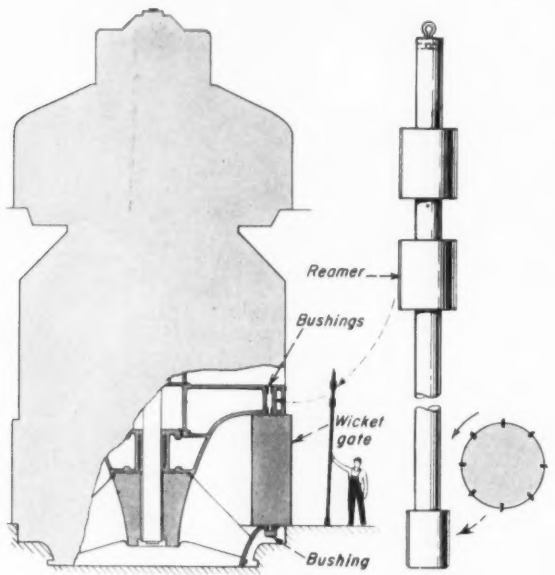
H7-3

**ELLIOTT Company**

Steam Turbines • Motors • Generators • Deaerating Heaters • Ejectors • Condensers • Centrifugal Compressors • Turbochargers • Tube Cleaners • Strainers

# More PRACTICAL IDEAS

Begins on page 120




## We made a man-sized reamer for a man-sized job

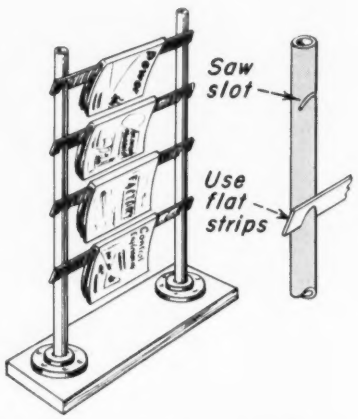
When overhauling water turbines and renewing the bushings in the head cover and distributor ring, you usually have to do some buffing on the bushing's inner diameter before the wicket-gate's stems fit properly.

With new bushings in head cover and ring, head cover is always lowered into place, but without the wicket-gates. A "try-shaft" is used to check the alignment of the upper and lower bushings. In older units, poor alignment is often caused by concrete settling or a shift that puts the entire machine out of line. These units have tendency to shift downstream.

Alignment was so bad on our unit that we had to take more drastic steps. But the machine was badly needed. Rather than waste time buffing, one of our foremen suggested making a reamer out of our try-shaft. He removed gages on the try-shaft by turning them down on a lathe. Then he slotted shaft in milling machine.

Extra long carbon steel cutoff tools were inserted in the slots and lightly brazed into place. Reamer was returned to lathe, cutting edges ground to proper diameter and rake. With this reamer suspended from a chain-fall from crane, reaming job was done in less than a day. This idea has other uses.

L McWILLIAMS, *Shawinigan Falls, Que.*




## Need a magazine stand?

Our plant subscribes to several technical magazines. As soon as current ones are received, they are placed on a ladder-type rack, sketch. Stand is similar to those used in libraries for newspapers. Each magazine is well displayed. Best feature is that one glance at rack tells which one is being used.

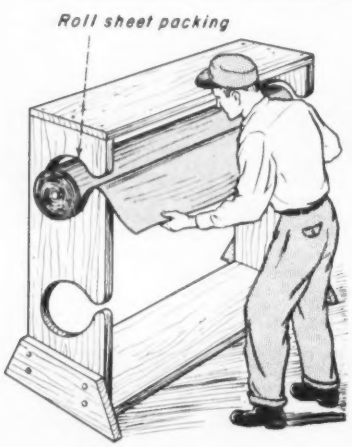
C H WILLEY, *Concord, N. H.*

## Did you know . . .

that while low stack-gas temperatures usually stand for efficient boiler operation, they can cause trouble at times? Besides carbon and hydrogen which create most heat from combustion, fuels often contain impurities like sulfur. Then as fuel burns, sulfur combines with air to form oxides. Oxides pass up the stack with the waste gases.

Trouble starts if gases are cooled to the condensation point. Moisture is formed when hydrogen burns, producing droplets of water. This moisture combines with oxides of sulfur to form highly corrosive acids. If you have this condition, watch for costly stack corrosion which is sure to come.

If your stack temperature runs below 350 F, beware of this common trouble. Check with boiler manufacturer and fuel supplier for ideal operating conditions. Also, during plant shutdown check your metal stack for signs of corrosion from this cause.




## Handy sheet-packing stand

Our storekeeper made a bench stand for storing and handling rolls of sheet packing. It's very handy and easy to make. Rolls are slipped into it from the ends. Feature of this rack is that packing doesn't unroll unless pulled.

C H WILLEY, *Penacook, N. H.*

## Don't forget . . .

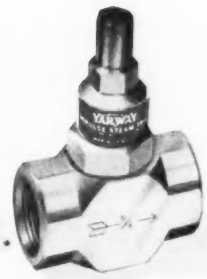
that failure to use feedwater treatment, using treatment improperly or using wrong treatment causes more boiler deterioration than any other factor.

## My biggest boner

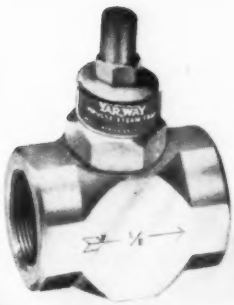
*Please turn to page 208*

½" No. 60 or 120

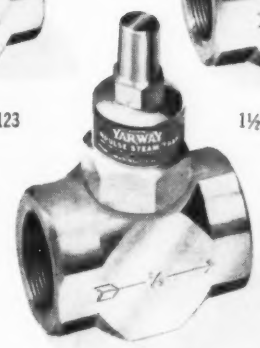
¾" No. 61 or 121



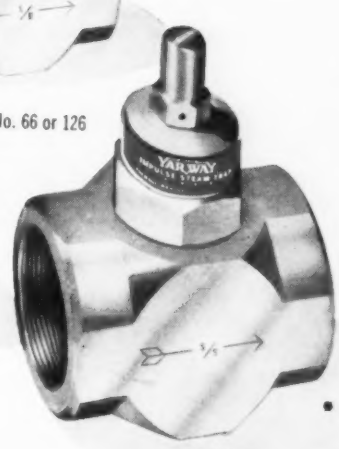
1" No. 63 or 123



1½" No. 66 or 126



1¼" No. 64 or 124



2" No. 67 or 127

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Take your choice! There is a Yarway Impulse Steam Trap for practically every trapping requirement in your plant.

*Revolutionary* when introduced 20 years ago, the *Yarway Impulse* principle has been proved by more than a million in service everywhere, is still gaining new friends every day.

**SERIES 60**—for *normal steam trap requirements;* pressures to 400 psi, temperatures to 450° F. Stainless steel body and working parts. Six sizes, ½" to 2".

**NO. 20-A**—available in ½" size only— similar to ½" #60, but with low capacity—designed especially for *light condensate loads.*

**SERIES 120**—same as Series 60 but for higher pressures and temperatures (600 psi, 750° F). Featuring all-stainless steel construction. Six sizes, ½" to 2".

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**INTEGRAL STRAINER TRAPS**—for marine use and for high pressure trapping service in steam power plants with pressures up to 2500 psi. Six sizes, ½" to 2"; flanged and socket-welding ends.

All Yarway Impulse Steam Traps are available through 270 convenient local Industrial Distributors. For descriptive bulletin on any type of Impulse Trap, write . . .

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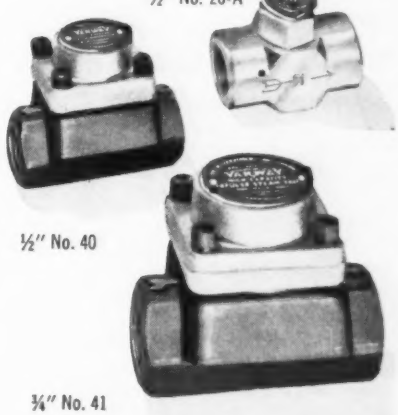
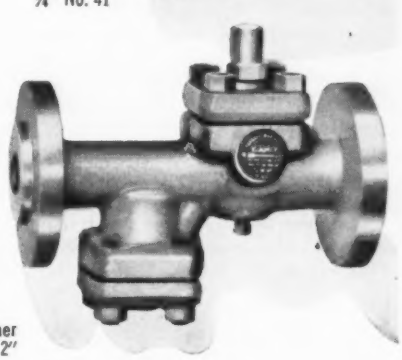
½" No. 20-A



½" No. 40



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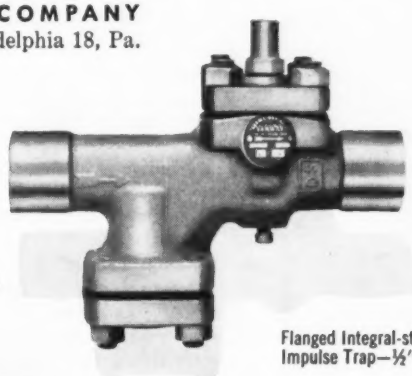


Socket-weld Integral-strainer Impulse Trap—½" to 2"

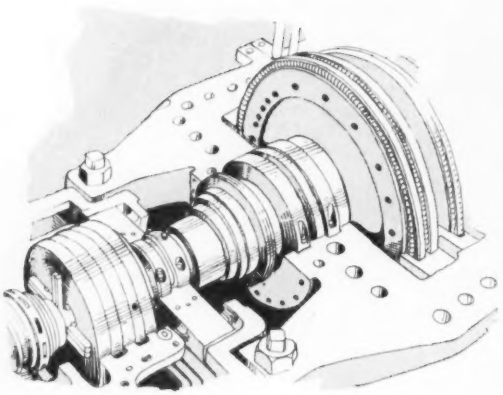


Flanged Integral-strainer Impulse Trap—½" to 2"

**YARWAY IMPULSE STEAM TRAPS**

The Impulse that revolutionized steam trapping 20 years ago

# *Have a* PLANT PROBLEM? *Tap the*



## The problem

## What caused turbine thrust bearing damage?

**A 70-mw turbine-generator is fed by two boilers producing 290,000 lb steam per hr. With the first boiler at 940 psi, 914 F, generator output was 30 mw.**

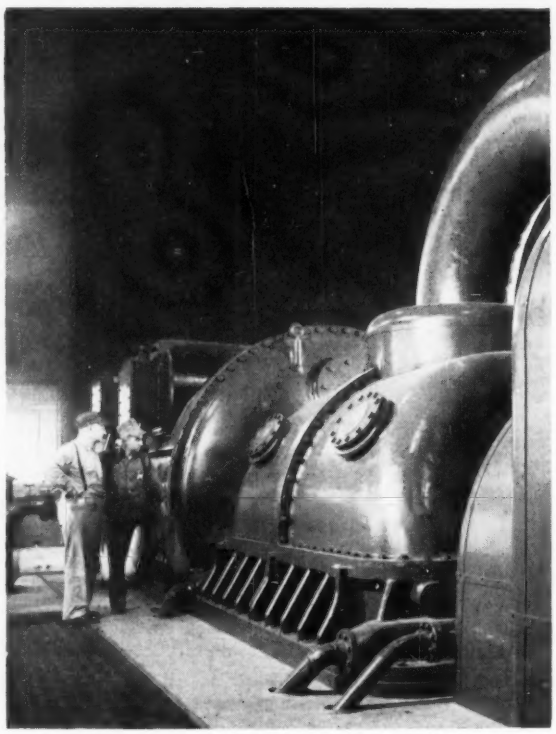
**Second boiler pressure was 925 psi, temperature 875 F, and water level a little below half full. After operating conditions had been carefully checked, second boiler was put on the line. Its water level went a little above half full and generator output rose to 32 mw before trouble occurred.**

**The steam turbine sustained a shock and the generator lost 12 mw almost immediately. Pressure of the second boiler rose to 940 psi. Operator immediately reduced it. At the same time the minimum bearing clearance alarm operated and its oil temperature went from 130 to 135 F. Then the height eccentricity alarm between turbine stator and rotor operated, but only instantaneously. The recorder showed that the turbine shaft was displaced 1.5 millimeters on the low-pressure side, along the axis.**

**Under these conditions the units were shut down.**

**When the thrust bearing was removed it appeared damaged, with considerable material carried away. What caused this trouble?—*WF, May Power***

## The solutions



### Steam could have picked up a slug of water

There are probably many scientific answers as to what caused the turbine thrust bearing damage. But it looks to me as though steam from the second boiler picked up a slug of water somewhere in transit to the turbine. This water slug caused the damage. I would guess that the amount of water was not too great because the blading wasn't damaged.

Water could have been picked up in two places. First place would be the boiler stop valve, the water being trapped there because of a closed or defective seat drain valve. But, since the generator load increased two mw before the shock occurred, the turbine *was* receiving steam, so we can discount this possibility.

Let's go back to the boiler water-level indicator. According to the problem, the water level showed a little below half full before the boiler was put on the line, and a little above half full immediately after. Thus, when the boiler went on the line, pressure drop caused the feedwater regulator (trying to keep drum level constant) to open too wide and stick momentarily, allowing drum level to rise too high. So steam could have carried drum water to the turbine. I'll bet that the superheater charts show a temperature drop at the time of shock.

Since a 12-mw loss was sustained almost immediately, the turbine was losing speed and the turbine governor could not

control the loss momentarily. Thus the sudden rise in steam pressure.

Operation of both thrust and height eccentricity alarms indicate that the turbine spindle was bouncing and jumping at the same time. The only factors that could cause this are a broken bucket or a water slug. No buckets were missing so the culprit must have been a water slug.

H C Bosley, *Long Beach, Calif.*

## Flash steam from second boiler could have caused trouble

Without question the turbine was damaged by a heavy water slug carried over with the steam. The shock and pressure developed in driving the water through the turbine, overloaded the oil film on the thrust bearing and metal-to-metal friction caused the damage.

Water carryover had to come either from water trapped in the line or from the boiler itself. Water trapped in the line could only come from faulty design or operating procedure. Boiler carryover should register as a sudden drop in steam temperature.

The second boiler, at 925 psi and low flow, would actually be at a somewhat higher pressure than the line, because of the superheater drop at high flow through boiler No. 1. When boiler No. 2 is cut in, pressure would tend to equalize and water would flash to steam throughout the boiler. Result: A sudden water rise which might very well carry through the separator and superheater, into the line.

A definite circulation pattern is set up in a steaming boiler as a result of heat input and steam generation. A boiler put on the line with little steam flow has little circulation. If cut in above line pressure, water flashing to steam can interrupt or reverse circulation, cause water to rise in the steam drum. Possibility of a nonreturn valve sticking would further aggravate this condition.

G C Archer, *Springfield, Ore.*

## WF lucky turbine rotor wasn't ruined

There is only one possible reason for *WF's* turbine trouble: water in the steam carried over from the boilers. Turbine sustained a heavy shock and a drop in turbine output. The heavy vibration together with an unstable pressure against the balance piston caused the surprisingly great force against the thrust bearing. *WF* was lucky the turbine rotor wasn't completely distorted and ruined.

Possible reasons for water in the turbine are: (1) Sudden pick up of generator load. Pressure drop in the boiler raised water level, causing water carryover. (2) If boiler No. 2 just went on the line, there could have been water in the superheater. (3) Boiler No. 1 dropped load too fast. Thus boiler No. 2 sustained a sudden output boost of more than 2 mw, causing pressure drop and high water level. After generator output dipped to 20 mw, pressure rose in boilers. This may all happen in a relatively short time.

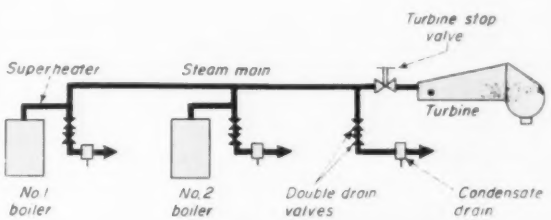
G Franssen, *Alberta, Canada*

## Second boiler put on line too soon?

I believe *WF's* trouble was caused by cutting in the second boiler before bringing boiler pressure up to line pressure. This could cause a slight instantaneous backflow as boiler and line pressure equalize. Resulting shock might be severe enough to damage the turbine.

ASME *Sugges'ed Rules for Care of Power Boilers* states, "In placing a boiler on the line with others already in service, keep its stop valve closed until pressure within the boiler is exactly equal to that in the steam line." But if the boiler is equipped with a nonreturn valve, it's permissible to open the valve before reaching line pressure.

F C Pechar, *Wallingford, Conn.*




## Did condensate accumulate in superheater or piping system?

Although both boilers were generating superheated steam, it's possible that moisture or a water slug was carried into the turbine during start-up of the second boiler. Whenever a boiler is shut down or is generating saturated or wet steam, condensate may accumulate in a pocket of the superheater or the piping system.

Some superheater designs don't have adequate means for draining during start-up and, unless there is provision for condensate removal, chances are good that moisture will be carried over. Also, many steam generators provide for separating moisture from steam in the drum by mechanical means such as cyclone separators and baffles.

Similar condition exists between superheater outlet and turbine inlet, especially when leads from two or more boilers tie into a header. Gate, globe and check valves have pockets which tend to trap condensate. So, provide for drainage. Pitch the piping with drip pockets and drains at low points. Sketch, above, shows a design that will avoid these problems.

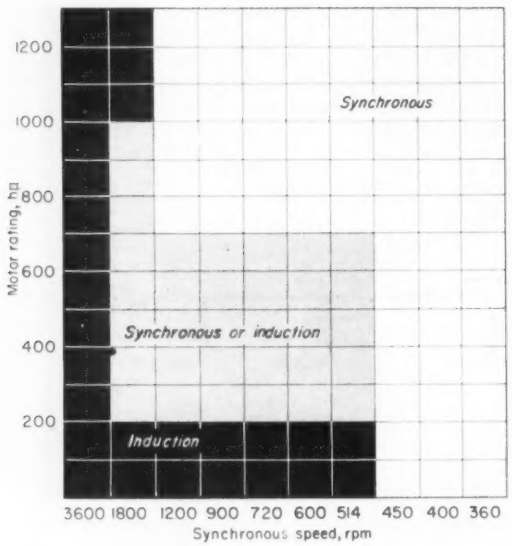
H B Wayne, *Woodhaven, N. Y.*

**Want help with your plant problems? Send your design and operating headaches to us. We'll put Power readers to work on them**

Turn page for info on motor selection ▶

# More PLANT PROBLEMS

Begins on page 126



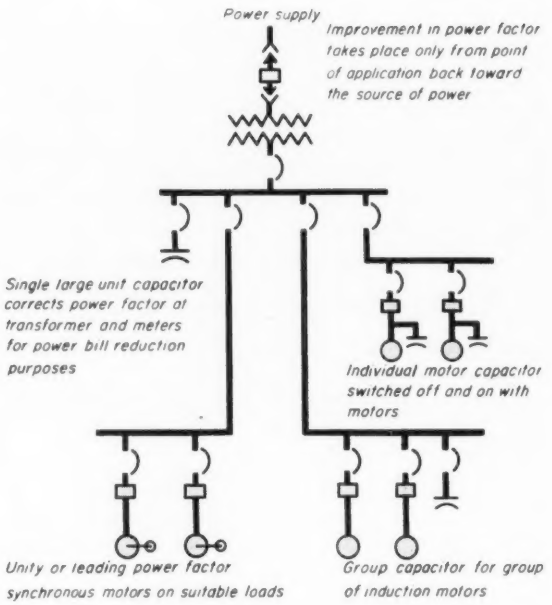

## The problem

## Should we use a synchronous or induction motor?

**In expanding our process we must add several blowers in the plant. These units are 350 horsepower each, and will require motors with a synchronous speed of 900 rpm.**

**We have never been penalized by our local power company for too low a power factor so we wouldn't go to synchronous motors for this reason alone. But we are wondering which we should choose, synchronous or induction motors. We naturally want to consider cost and efficiency.—*HEC, May Power***

## The solutions


Power supply
Improvement in power factor takes place only from point of application back toward the source of power
Single large unit capacitor corrects power factor at transformer and meters for power bill reduction purposes
Individual motor capacitor switched off and on with motors
Unity or leading power factor synchronous motors on suitable loads
Group capacitor for group of induction motors

### Let's work out an example

*HEC* says that his plant has not been penalized for low power factor. Regardless of power company policy, there are good reasons for high power factor. It cuts down required transformer kva and *ir* loss by keeping the reactive component low.

Let's take an example: Kw required for a 350-hp 440-v induction motor at 85% efficiency is:

$$350 \times 746 / 1000 \times 0.85 = 310 \text{ kw}$$

At 85% power factor the kva is

$$310 / 0.85 = 365 \text{ kva}$$

For an estimated five units, total kva would be 1825 kva.

Current flow for the five units is:

$$5 \times 310 \times 1000 / 440 \times 1.73 \times 0.85 = 2400 \text{ amp}$$

Copper loss for 85% pf is 135% of that for unity pf.

$$(365^2 - 310^2)^{1/2} = 192 \text{ kvar}$$

For five units this would amount to 960 kvar.

With synchronous motors, pf can be kept at nearly unity. And if motors are designed for leading pf, they can correct for inductive loads. Voltage can then be regulated within close limits. Blower loads, if steady, should be ideal for this type of motor. A 350-hp synchronous motor, fully loaded, would draw about:

$$310 \times 1000 / 440 \times 1.73 = 410 \text{ amp}$$

Because there is no reactive component, transformer capacity saved would be about 1800 kva.

Of course, choice of motor type should be governed by comparative costs of both types and of operating conditions.

Induction motors are simple, rugged and require less

For more on motor selection and new problems, turn page ▶

"OUT IN THE OPEN"

# Vogt

## Steam Generators

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and
PETROLEUM REFINERIES

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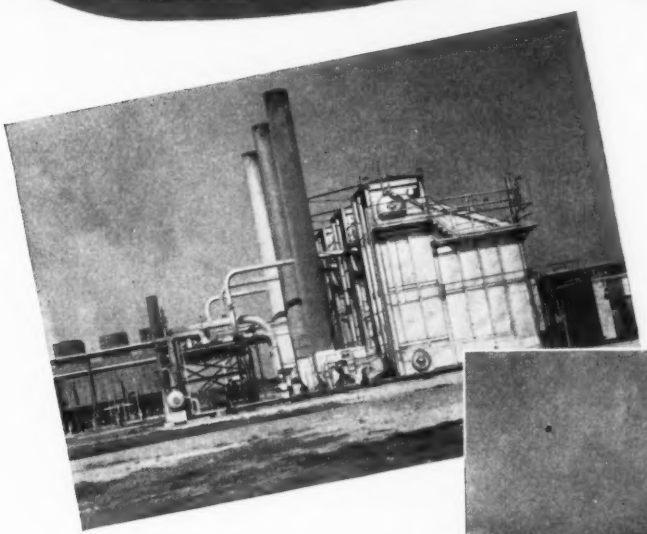
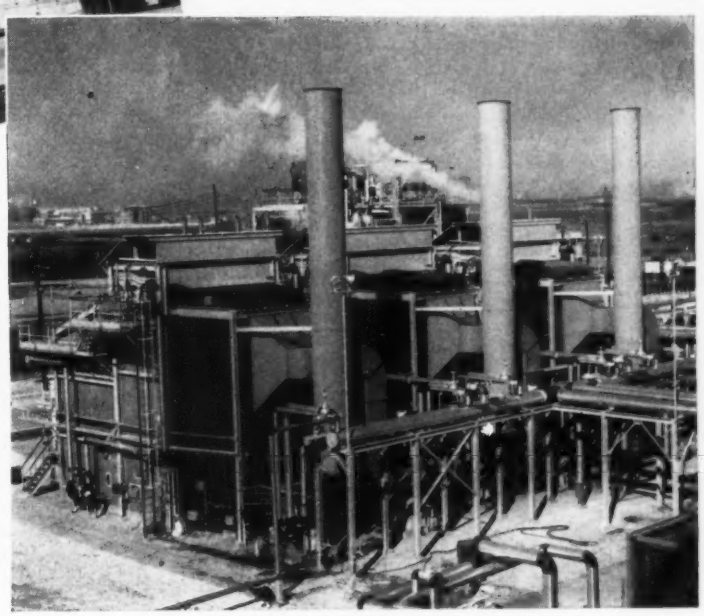
Get Vogt's recommendations for steam generators to meet your needs for power, processing, or heating, without obligation. Package type and custom built units are available in a wide range of types, capacities, and pressures to meet operating requirements.

***Write for bulletins. Dept. 24A-BP***



*Three 85,000 #/hr. steam generators in a Texas refinery.*



*An outstanding chemical plant served by three 150,000 #/hr. units.*

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maintenance, switching equipment, etc. Should conditions call for it, capacitors may be added to correct pf and voltage.

Sketch on p 128 shows two methods of connecting capacitors. Single large unit or small units may be used.

A H MOULTON, *Pittsfield, Mass.*

## I favor the synchronous motor

Although *HEC* hasn't been penalized for low pf, he has no assurance that the utility company won't penalize him in the future. Also, has he considered demand charges?

Dollar for dollar, the percentage difference in the total investment for motor and starting equipment is small. So it pays to check with the contractor installing the units.

Regardless of initial cost, I favor the synchronous motor and its ability to boost overall plant efficiency.

C BACHMANN, *Jamaica, N. Y.*

## Synchronous motors save $$

A leading power factor synchronous motor will result in leading kva in a ratio depending on the power factor. For a motor of 350 hp, leading kva can be produced at a far lower cost than by any other means.

Although the power company may not be charging a penalty for low power factor, your electric bills are based on *demand* and power factor. A low power factor increases power costs. In addition, distribution lines, feeder lines, switches and other gear must be bigger in a low pf system. Put another way, present wiring can handle larger loads when pf is increased in a low pf plant.

An increase in pf from 85 to 95% can save enough money to probably pay for the synchronous motors within three years, especially if plant electrical load is very high.

M L ZIDEL, *Brooklyn, N. Y.*

## Would power company offer a better rate if *HEC* raised power factor?

*HEC* says the power company doesn't penalize him for low power factor. But, would they offer a better rate if power factor were raised? It might pay to ask.

Induction motors are considered more rugged, cheaper in first cost and easier to operate than synchronous motors. But, in addition to the power company rate, there are advantages in using synchronous motors. There is the matter of transformers, control and conductors in the plant. All these items affect voltage regulation. By using synchronous motors there might be a big saving in rewiring because of increased power factor. In contrast, the plant may be arranged so no extra cost results from adding induction motors. If the latter is true, induction motors will be best.

E A ROBERTS, *Carlsbad, N. M.*

## Synchronous motor controls pf

As a general rule, decision to use either synchronous or induction motors depends on economics. Quotations, giving efficiency, costs, losses, will help *HEC* come to an intelligent decision.

Although the synchronous motor may be slightly higher in cost, its efficiency and its ability to control power factor at all loads, may more than balance higher investment cost.

Present day synchronous motors are as rugged as induction motors. And, although *HEC* hasn't been penalized for low power factor yet, the addition of one or more synchronous motors may come in handy in the future.

C O VON DANNENBERG, *Brooklyn, N. Y.*

# Your August problems

## How can we keep moisture, oil out of our compressed air?

**Compressed air is an important power service in our plant. We have three centrally located 125-psi 700-cfm air compressors. They're heavy-duty two-stage double-acting water-cooled vertical-V design. Drives are electric motors.**

**The central compressed-air system is equipped with both intercooling and aftercooling. During some recent maintenance work we've noticed that air being delivered to pneumatic tools has been carrying moisture and oil, adversely affecting tool operation. We're also concerned about the corrosive action on both tools and air system. Can *Power* readers tell us how to lick this problem—*CMJ***

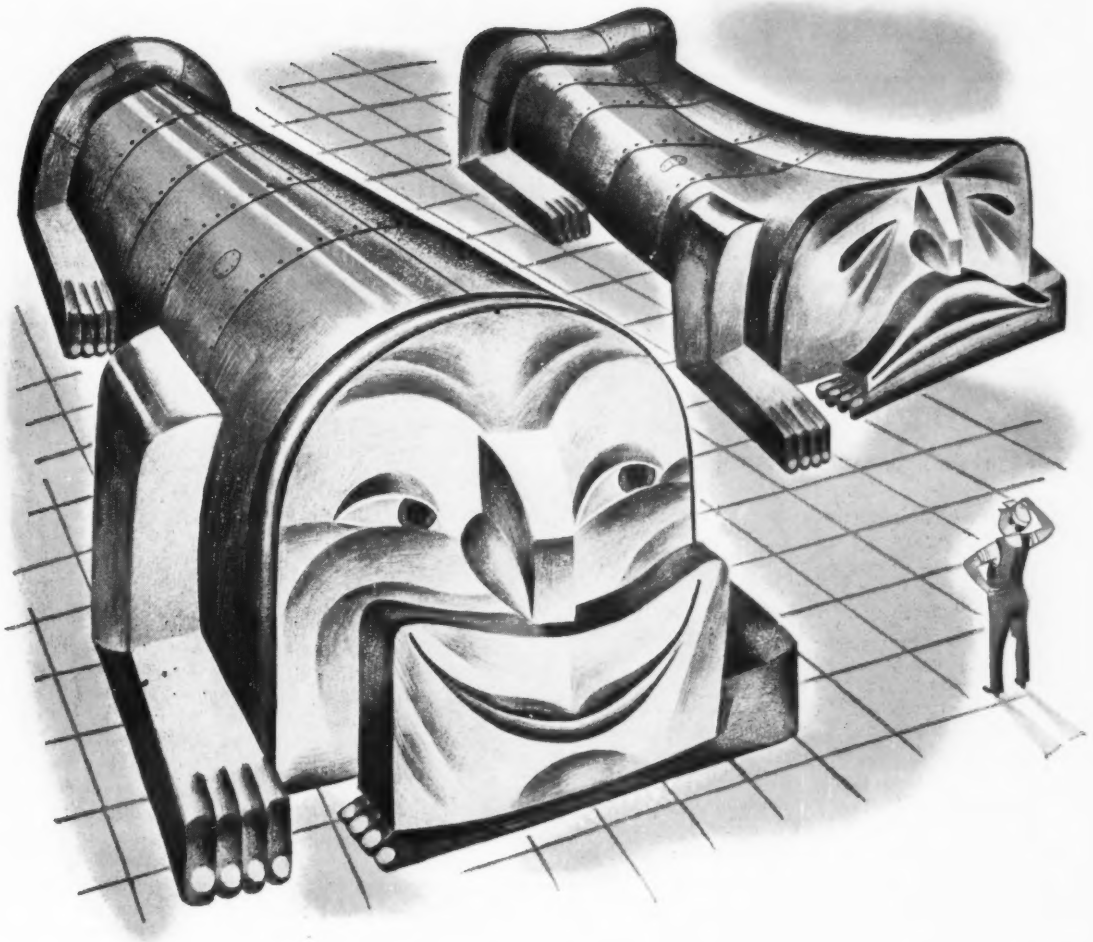
## Can vibrations caused by firing be reduced or eliminated?

**We have several low-pressure Scotch boilers fired with horizontal rotary burners using No. 6 oil.**

**At low firing rates we get a mild combustion rumble. When the firing rate is increased, resonance is increased to such an extent that sympathetic vibrations are set up in the building. Noise in the boiler room is so severe that cracks develop in the flue covering and general deterioration sets in throughout the plant. It just isn't good operation.**

**What can be done to stop the resonance? If *Power* readers have had similar problems and solved them, I'd appreciate hearing of their experiences.—*ABW***

Sit down right now and answer one or both problems. We'll pay extra for answers with photos, sketches.



# Will it Generate or Degenerate?

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# ARGUMENTS . . . *let other readers know your views*

ALTHEA THORNTON, *Assistant Editor*

## Three views on Gill's lubrication program

► LAST MONTH, C A Gill suggested a four-point program to solve plant lube problems without fuss (*Arguments*, July, p 134). We asked engineers in several plants what they thought of his program. Here are their comments:

### Many plants need lube engineers

Our experience shows that one must supplement the oil company and machine manufacturer's experience in a well-integrated plant lubrication program.

As yet, we have not been able to write a cook book for lubrication. There is a great difference of opinion as to what constitutes successful and unsuccessful operation of mechanical equipment.

An oil company representative is walking on a tight rope when it comes to criticizing equipment. Any mechanical or lubrication change transfers responsibility from machine manufacturer to oil company. So tendency is to leave things as is.

Fortunately, a great deal of mechanical equipment is well-designed and can operate successfully with a wide latitude of practices. It's equally true that one often has to modify design and set up elaborate procedures to insure continuous operation.

I take exception to Gill's statement, "I do not think a man need be (a lubrication engineer) in order to have successful plant lubrication." Lubrication engineers have to justify their existence the same as other employees. The steady growth in their number and the strengthening of their position as an engineering profession indicates that they are serving a useful purpose.

CHARLES POPE, *Eastman Kodak Co*

### Our lube experience parallels Gill's

In a plant containing much slow-moving heavy equipment with many open gears, we found that we were using twenty one separate lubricants, many of them highly specialized premium-priced types.

We spent two weeks surveying our plant with a lubrication engineer from a leading oil company. Result: a reduction to eleven lubricant types (later increased to sixteen), all standard nonpremium grades. We watched their performance closely for several months, found very few changes necessary.

Net result was a reduced lubricant bill, simpler greasing and oiling operation, and as good or better performance of all equipment.

We have eliminated over-greasing by using sealed bearings in many cases. We also made horsepower checks on various lubricants used on open gears, to find which increased the motor loads.

Lube timing governs over- and under-greasing to a great extent and we have made up charts indicating when to lubricate. Gill doesn't mention the importance of changing oil, flushing reduction gears and transmissions periodically to protect gears and bearings.

Of course a good oiler is invaluable. In addition to being oiler and grease man, he automatically becomes an inspector, reporting noisy equipment, misalignment, overheating, lube performance, etc.

J A PANELLA, *W P Fuller & Co*

### Organize the job, study true costs

The true cost of lubrication may include: (1) cost of lubricants (2) inventory and handling charges, including costs of requisitioning, receiving, storage space (3) waste, caused by contamination, obsolescence, spoilage (4) waste and time used to get lubricants from stock container to area of use (including types, size of dispensing equipment, method of filling, also, time for cleaning when using same equipment with different lubricants (5) amount of lubricant used, including surplus and waste (6) service life, change periods (7) labor cost to get lubricant to the fittings and to change lubricants, times frequency of lubrication (8) machine downtime, for lubrication and for repairs caused by wear or failure (9) maintenance parts and labor for repairs (10) product spoilage (11) clerical and record-keeping costs.

An oil company representative can and will help solve plant lube problems. But plant maintenance or engineering must develop and review procedures and methods, decide on cost-saving devices like manual central systems, automatic systems, constant level oilers. Other items beyond the normal scope of an outside helper include: methods and equipment for economical dispensing, development of realistic lubrication schedules, follow-up on breakdowns or wear.

The small plant may not require the full-time services of a lubrication engineer, but time spent in training a good supervisor or engineering assistant, and then permitting use of this information in an intensive survey, can pay handsome dividends.

Selecting the oiler *is* quite important, but no more so than dignifying his job by giving him formal training, providing labor-saving tools and equipment, and permitting him to suggest or make changes to ease his work. If he also notices and reports incipient machine troubles during his rounds, his job is more interesting, and he is of more service.

Gill's lube program hits the nail on the head, but let's not underestimate the value of a little extra time in organizing the lubrication job, studying the true costs and planning for reducing them.

A F DELONG, *Electric Storage Battery Co*

# About the Cost of Living . . . with Steam Traps

WHEN YOU specify steam traps, what could possibly be more important than *the cost of living with them*—production cost . . . steam cost . . . downtime cost . . . repair cost.

No steam traps manufactured have ever provided greater equipment operating efficiency or lower trap maintenance cost than Armstrongs.

Consider the experiences of these companies:

*"30% Greater Output* from platen presses since installing Armstrong Traps"—rubber processor.

*"$8000 Annual Fuel Saving* since replacing 600 traps with Armstrong"—metal processor.

*"30% Less Downtime* for repairs with Armstrong Traps"—food processor.

*"$25,000 Trap Maintenance Saving* every year since installing 4000 Armstrong Traps"—major chemical plant.

You may well ask, "Can there really be so big a difference in steam trap performance?" The answer is: These are typical experiences of people who have compared Armstrong trap performance—not for a month or a year, but over periods of 2, 5 and even 10 years or more.

*The Armstrong trap has certain fundamental advantages, including:*

***No Steam Loss*** – the valve is always water-sealed.

***Large air-venting capacity*** – air is automatically discharged along with condensate.

***Long-life parts*** – hardened chrome steel valve and seat – all other parts corrosion-resistant stainless. Absolutely nothing to stick, bind, clog or collapse. Not affected by ordinary dirt and scale.

***Unconditionally guaranteed to satisfy.*** It takes an awfully good product to carry such a guarantee.

Steam traps can have such a big effect on plant operating efficiency, they are worth more than casual consideration. Let your Armstrong Factory Representative answer your questions. There is no obligation. Call him or write:

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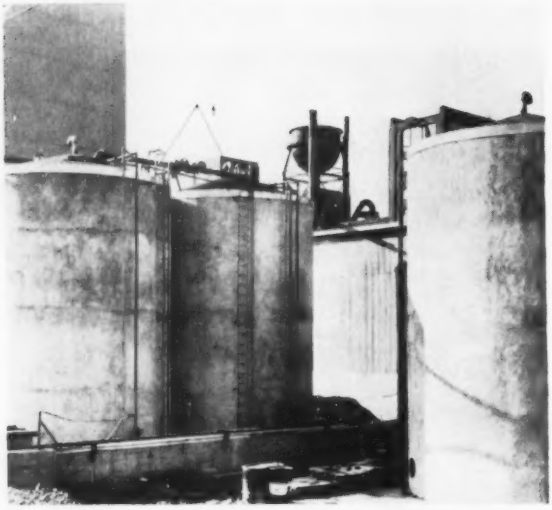
Do you have "The Steam Trap Book"?—44 pages of useful data on trap sizing, calculation of condensate loads, installation and maintenance. Free on request.

# ARMSTRONG STEAM TRAPS

# HOW TO

## fireproof and insulate oil tanks

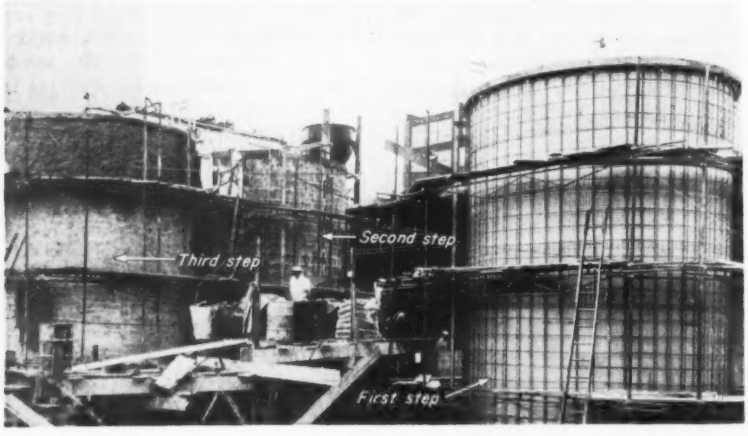


1 Completely fireproofed with 6-in. perlite concrete, these fuel tanks meet fire regulations, won't rust; look well

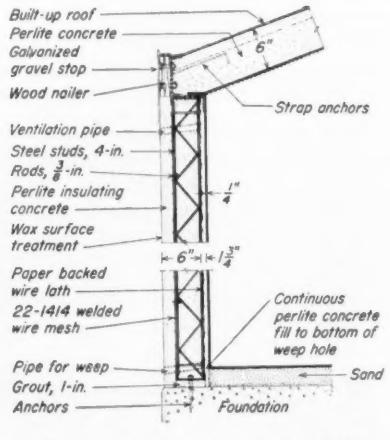
2 Perlite is machine-sprayed onto a paper-backed wire lath that's attached to steel stud framework around the tank

► One firm wasn't allowed to enlarge its factory building because it was too close to a large fuel tank; clashed with municipal fire regulations. Approval was granted after fireproofing with perlite insulating concrete. This is a new protection for gasoline and oil storage tanks against fire and evaporation loss. Perlite, an expanded volcanic mineral used as an aggregate in concrete, protects metal from rust and weather, is rot- and verminproof.

Insulating property of 6-in. thickness perlite concrete and $1\frac{3}{4}$-in. dead air space has U value of 0.16. (U equals the heat transmission in Btu per hour, per sq ft, per degree F of temperature difference from air to air of a given building section.) This excellent insulation value is equivalent to more than three feet of structural concrete. Mix 4 cu ft of perlite to one bag of portland cement, 5 lb. Lumnite cement, 3 oz of NVX air entraining agent and 63 lb water.—*Courtesy, Perlite Institute*




3 First step is to surround tank with with paper-backed wire lath attached to stud framework. Next, spray on first coats of perlite concrete; third, finish spraying




4 Cross section of the 6-in. insulation barrier and air space around tank

Call on
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for
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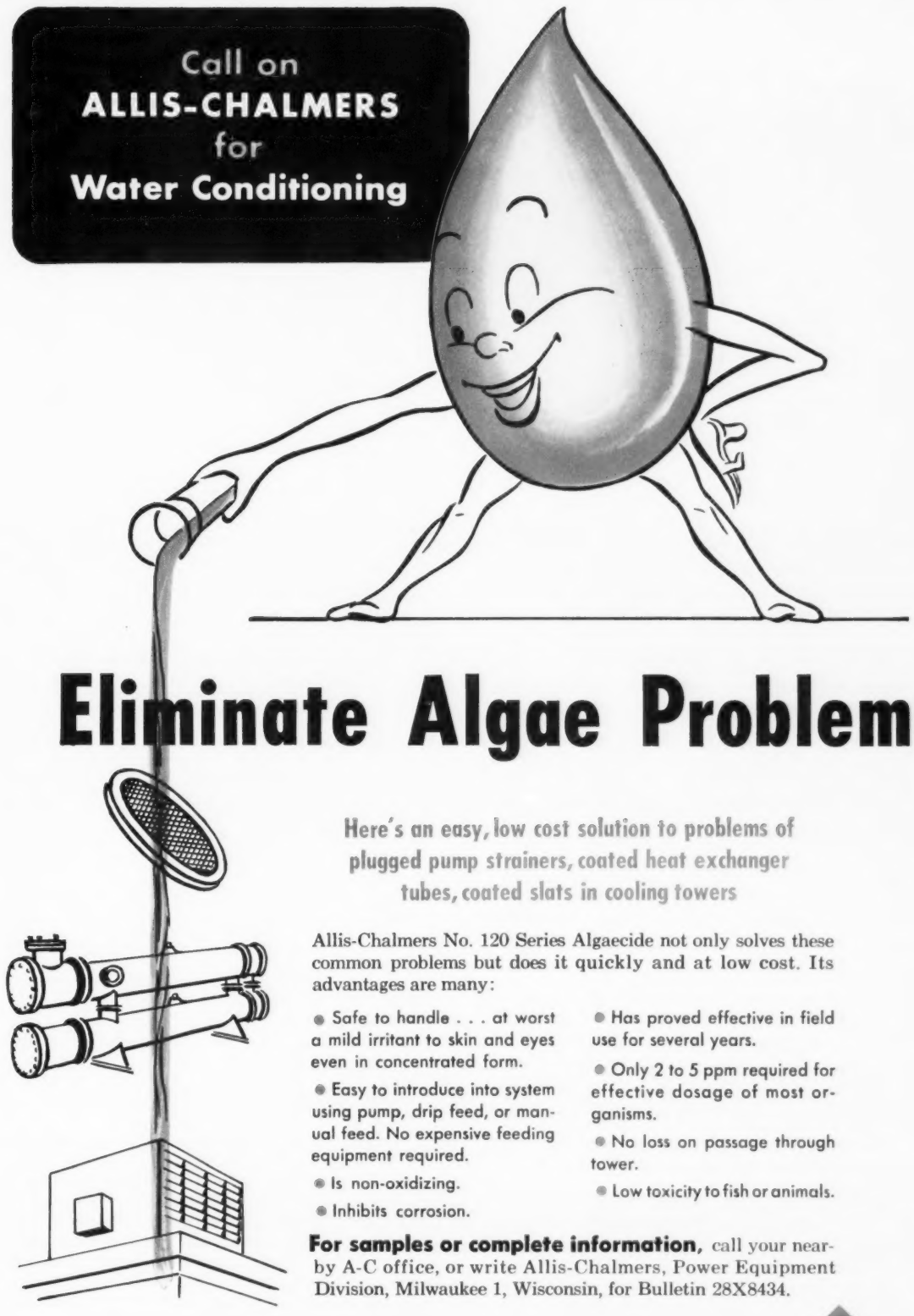

# Eliminate Algae Problems

**Here's an easy, low cost solution to problems of plugged pump strainers, coated heat exchanger tubes, coated slats in cooling towers**

Allis-Chalmers No. 120 Series Algaecide not only solves these common problems but does it quickly and at low cost. Its advantages are many:

- Safe to handle . . . at worst a mild irritant to skin and eyes even in concentrated form.
- Easy to introduce into system using pump, drip feed, or manual feed. No expensive feeding equipment required.
- Is non-oxidizing.
- Inhibits corrosion.
- Has proved effective in field use for several years.
- Only 2 to 5 ppm required for effective dosage of most organisms.
- No loss on passage through tower.
- Low toxicity to fish or animals.

**For samples or complete information,** call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 28X8434.

**ALLIS-CHALMERS**

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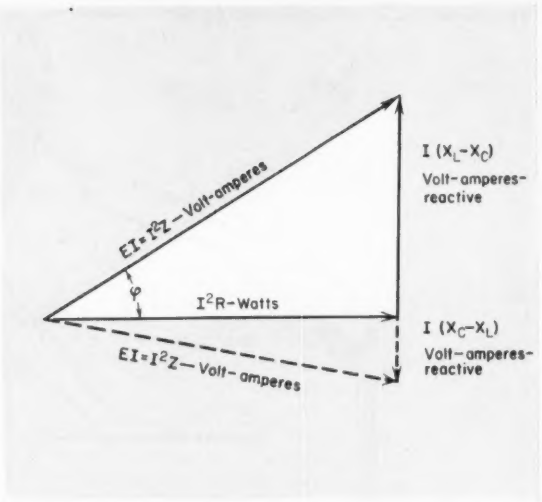
# BASICS . . . *bringing engineering theory down to earth*

NORMAN PEACH, *Assistant Editor*

Electricity: 13

# Voltage, current and power in ac circuits




► ALTERNATING CURRENT varies regularly from positive maximum to zero to negative maximum, as we have seen. The *average* current is therefore zero for each cycle. This is what we would read if we used a dc ammeter to measure alternating current. The varying alternating current does have an *effective* value $I$ and ac ammeters measure this value. An *ac ampere* is the current that produces the same amount of heat in a given resistor as one ampere of direct current.

It can be shown mathematically that for a sine-wave voltage or current the effective value equals $1/\sqrt{2}$, or 0.707, times the maximum value. Thus,

$$E = 0.707\ E_{max},\ \text{and}\ E_{max} = 1.41\ E$$
$$I = 0.707\ I_{max},\ \text{and}\ I_{max} = 1.41\ I$$

An *ac volt* is the emf required to cause one ac ampere to flow through one ohm of resistance. Ac voltmeters read the effective voltage, $E$ or $V$. Note that an alternating voltage subjects insulation to higher instantaneous stress than equivalent direct voltage. Effective values of ac waves are called *rms* or *root-mean-square* values because they are found by taking the square root of the mean (average) value of the squared current or voltage wave.

**Power** in single-phase circuits having ***resistance only*** can be found by the formula, $P = EI$ or $P = I^2R$. $E$ and $I$ are rms values. Power in these circuits can be measured using ammeter and voltmeter. In nonreactive circuits the product of volts times amperes, or *volt-amperes* (va) is equal to the watts.

Voltage and current waves of circuits with inductive or capacitive reactances are not in phase, as shown in last month's *Basics*. Therefore, the product of the rms current and voltage does not represent the true power in the circuit. *True power*, that is, power that produces work at some rate, results only from the resistive part of the circuit's impedance, $P = I^2R$, and is shown as the base of the power triangle in sketch, above. *Apparent power*, $EI$ or $I^2Z$, the hypotenuse of the triangle, is volt-ampere product. *Reactive power*, $I^2(X_L - X_C)$, the vertical side of the power triangle, is measured in *vars*. Reactive power produces no work. True power, apparent power, and reactive power are often expressed in units of 1000, that is, kilowatts (kw), kilovolt-amperes (kva) and kilovolt-amperes-reactive (kvar).

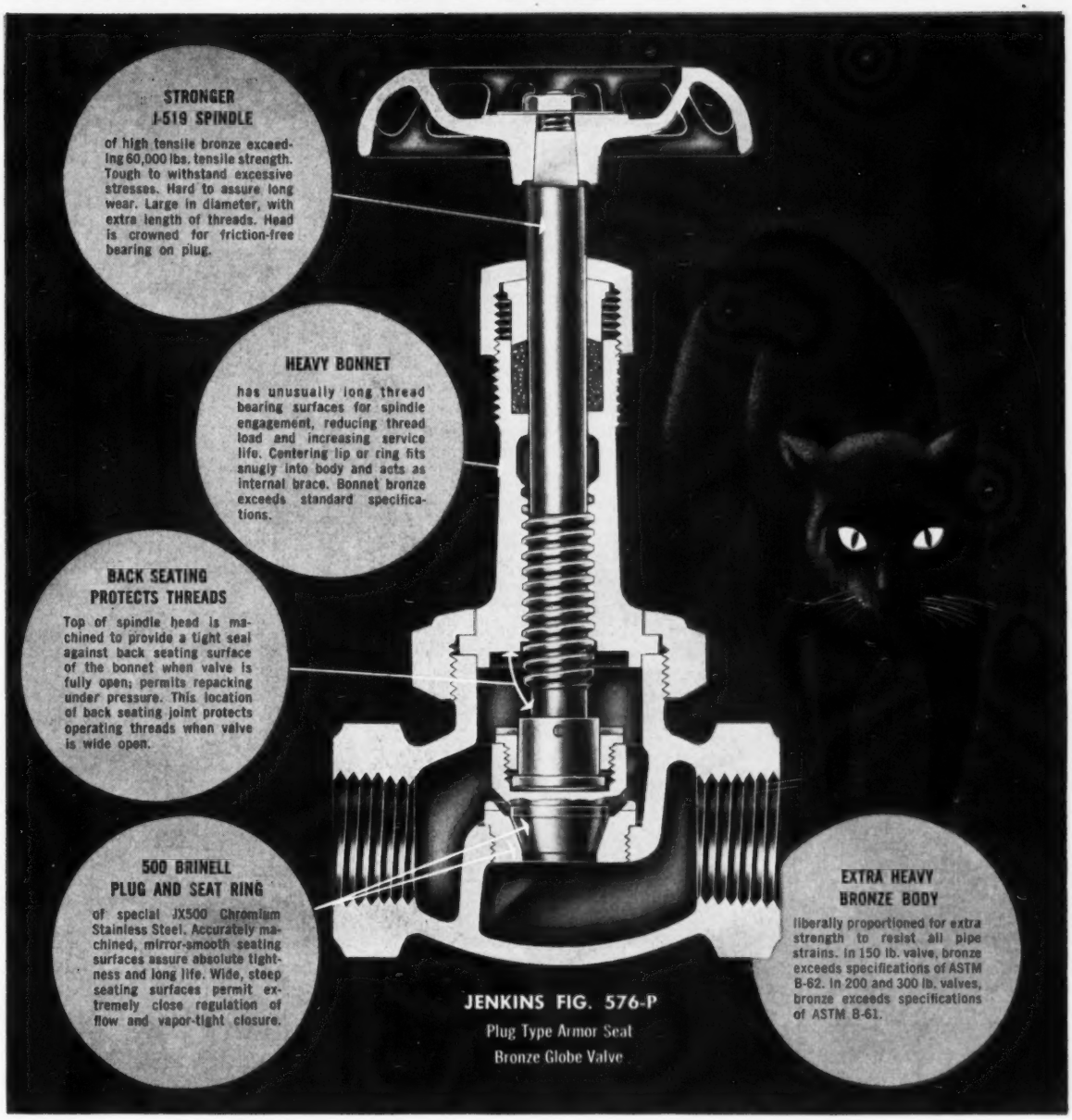
**Power factor** (pf) is ratio of true power (kw) to apparent power (kva). It's cosine of the angle $\phi$ in power triangle:

$$\text{pf} = \frac{I^2R}{EI} = \text{cosine}\ \phi$$

True power (kw) in single-phase circuits can be measured with a wattmeter as described for dc in *Basics No. 3*, October 1956. Apparent power (kva) is measured by voltmeter and ammeter. *Varmeters* are made, but you generally calculate kilovars when you know watts and kva.

The larger the power-factor angle, the smaller the power factor, and the smaller the true power is compared with the apparent power. Loads with low power factor (for example, underloaded induction motors) draw current that produces no useful work. This means that cables, transformers, etc. which supply the load will have to be larger to handle this unproductive current. By reducing the reactive power (vars), you increase the power factor, and apparent power more nearly approaches true power. Power factor is unity (1.00) when there is no reactive power. A power factor of 0.90 is considered good. Since, in most industrial plants, reactive power results from inductive reactance $X_L$, you can improve power factor by connecting capacitors in the circuit to produce $X_C$. (Reactive power $= I^2(X_L - X_C)$ It's possible, though seldom a practical problem, to have *negative* reactive power and a *negative* power factor. Condition occurs when $X_C$ is larger than $X_L$. In this case you can connect an inductor in the circuit to improve pf. *October's Basics: How to measure power in 3-phase circuits*

# Where valves need 9 lives...


STRONGER
I-519 SPINDLE
of high tensile bronze exceeding 60,000 lbs. tensile strength. Tough to withstand excessive stresses. Hard to assure long wear. Large in diameter, with extra length of threads. Head is crowned for friction-free bearing on plug.
HEAVY BONNET
has unusually long thread bearing surfaces for spindle engagement, reducing thread load and increasing service life. Centering lip or ring fits snugly into body and acts as internal brace. Bonnet bronze exceeds standard specifications.
BACK SEATING
PROTECTS THREADS
Top of spindle head is machined to provide a tight seal against back seating surface of the bonnet when valve is fully open; permits repacking under pressure. This location of back seating joint protects operating threads when valve is wide open.
500 BRINELL
PLUG AND SEAT RING
of special JX500 Chromium Stainless Steel. Accurately machined, mirror-smooth seating surfaces assure absolute tightness and long life. Wide, steep seating surfaces permit extremely close regulation of flow and vapor-tight closure.
EXTRA HEAVY
BRONZE BODY
liberally proportioned for extra strength to resist all pipe strains. In 150 lb. valve, bronze exceeds specifications of ASTM B-62. In 200 and 300 lb. valves, bronze exceeds specifications of ASTM B-61.
JENKINS FIG. 576-P
Plug Type Armor Seat
Bronze Globe Valve

## Install this JENKINS...made to defeat valve-killers

HERE are just five of the eighteen ways by which Jenkins Plug Type Valves have been engineered for maximum wear in valve-killing services. For any close-control steam service like drains, bypass lines, drips, blowoff, throttling, bleeders . . .

Or where abrasion, entrapped pipe chips, scale or rust tubercles are a problem . . .

You'll cut maintenance and replacement costs by specifying *"Jenkins Plug Type, with the 500 Brinell Stainless Steel Armor Seat"*. In the Jenkins Catalog are 150 lb., 200 lb. and 300 lb., Globe and Angle, screwed or flanged end valves in a full range of sizes. And, they are available quickly from local distributors' stocks.

*WRITE* us, or ask your Jenkins distributor for descriptive folder No. 202-A. Jenkins Bros., 100 Park Avenue, New York 17.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros

Sold Through Plumbing-Heating and Industrial Distributors

# Marmy's black gage glass

► I'VE BEEN IN Marmaduke Surfaceblow's doghouse since the May issue. Instead of saying that he used the $CO_2$ fire extinguisher from the welding shop to blow out the fuel-oil tank's vent line, our chemical symbols got fouled up and we said he blew it out with oxygen ($O_2$). As all you operators know, oxygen and hydrocarbons just don't mix. So Marmy's been sore.

Instead of going to his office above O'Houlihan's Machine Shop & Engine Works to see what he had to say this month, I got this story secondhand from his old shipmate, Tom Mullin of Seattle. This story is one of the most unusual we have ever heard—but it is absolutely true. Here's how Marmy told it to Tom.

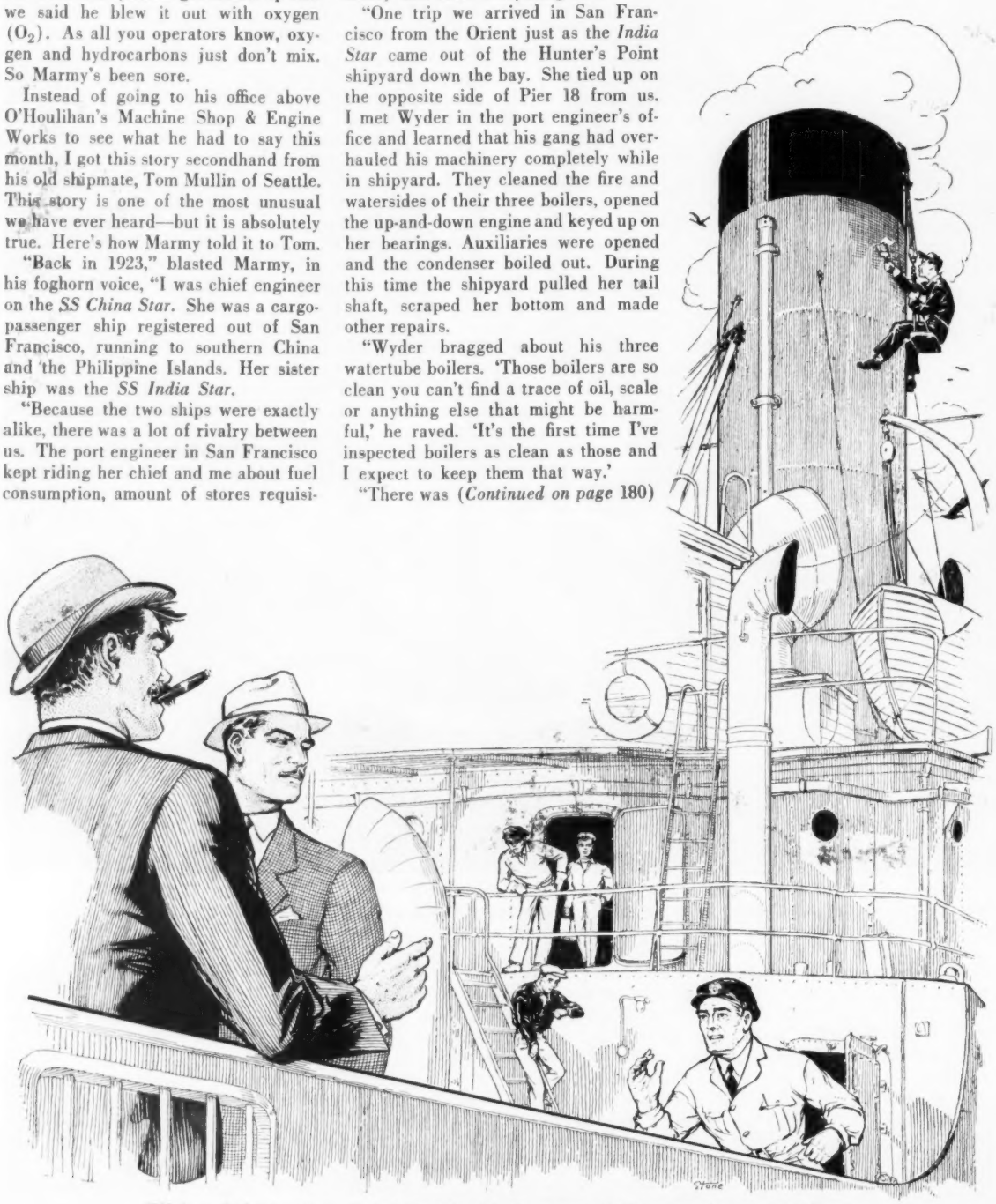
"Back in 1923," blasted Marmy, in his foghorn voice, "I was chief engineer on the *SS China Star*. She was a cargo-passenger ship registered out of San Francisco, running to southern China and the Philippine Islands. Her sister ship was the *SS India Star*.

"Because the two ships were exactly alike, there was a lot of rivalry between us. The port engineer in San Francisco kept riding her chief and me about fuel consumption, amount of stores requisitioned each trip and everything else. So her chief, Jack Wyder, and I did some pretty fancy figuring before turning in our log books each trip. But the two ships ran neck and neck in efficiency and most everything else.

"One trip we arrived in San Francisco from the Orient just as the *India Star* came out of the Hunter's Point shipyard down the bay. She tied up on the opposite side of Pier 18 from us. I met Wyder in the port engineer's office and learned that his gang had overhauled his machinery completely while in shipyard. They cleaned the fire and watersides of their three boilers, opened the up-and-down engine and keyed up on her bearings. Auxiliaries were opened and the condenser boiled out. During this time the shipyard pulled her tail shaft, scraped her bottom and made other repairs.

"Wyder bragged about his three watertube boilers. 'Those boilers are so clean you can't find a trace of oil, scale or anything else that might be harmful,' he raved. 'It's the first time I've inspected boilers as clean as those and I expect to keep them that way.'

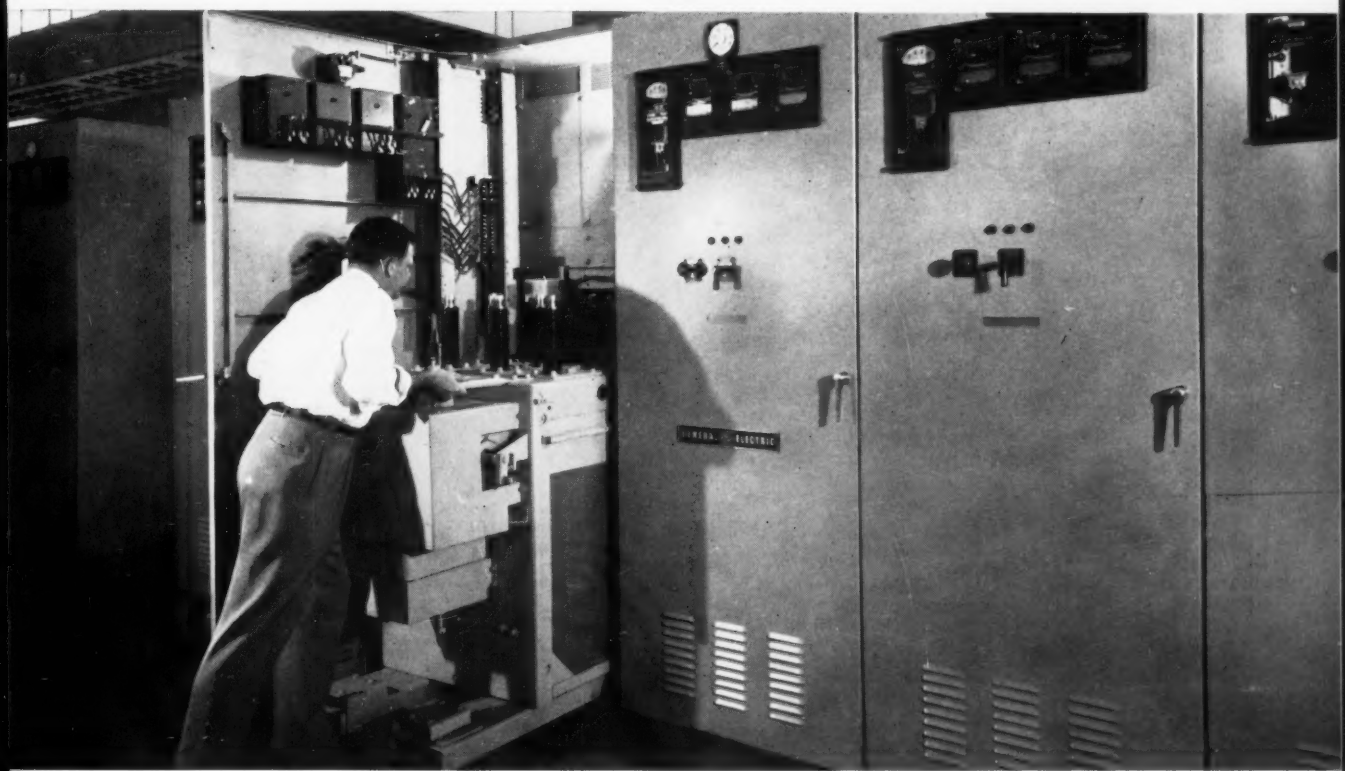
"There was (*Continued on page* 180)

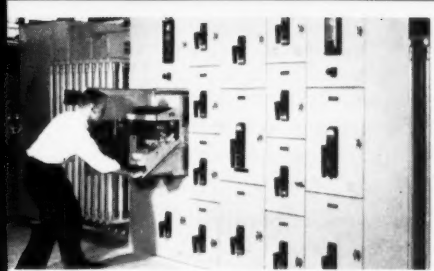


"Wyder rushed out on deck. He looked mighty sick, like a man who had seen a ghost," roared Marmy

# SAFE

## HELP PROTECT PERSONNEL AND EQUIPMENT WITH FIELD TESTED GENERAL ELECTRIC POWER DISTRIBUTION SYSTEM





**SAFE** system interrupting capacity is provided by draw-out air circuit breakers for circuit protection up to 600 volts.

**SAFE** control of lighting or power circuits is provided by panelboards with CLF fuses or circuit breakers.

Adequate interrupting capacity in your plant power system is a must in order to provide for the safety of personnel and equipment. General Electric completely enclosed equipment has been thoroughly tested to full rating with Magne-blast circuit breakers in their compartments. These field tests help to provide maximum safety for your power distribution system. For expert assistance in providing your system with adequate interrupting capacity, consult your nearest General Electric Apparatus Sales Office.

*To help make your plant's power distribution system:*

● SAFE ● RELIABLE ● FLEXIBLE
● ECONOMICAL ● EXPANSIBLE

Write to General Electric Co., Section B680-8, Schenectady 5, N. Y. for:

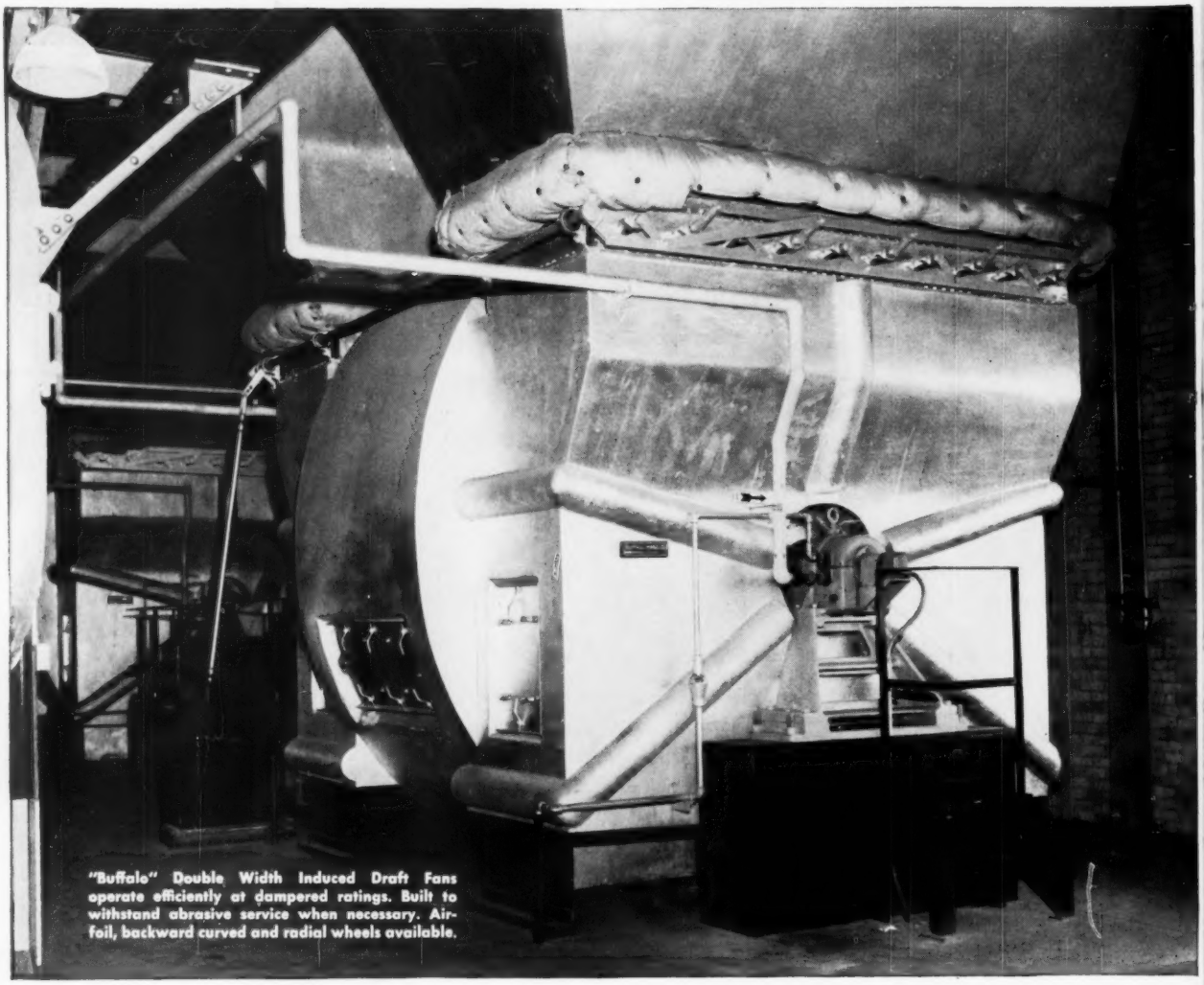
- ☐ G-E Power Distribution Library
- ☐ Information on color movie "Goodbye Steve," the industrial power story.
- ☐ Information on color movie "Appointment in Philadelphia," the General Electric metal-clad switchgear product story.

NAME _____

COMPANY _____

ADDRESS _____

GENERAL ELECTRIC



"Buffalo" Double Width Induced Draft Fans operate efficiently at dampered ratings. Built to withstand abrasive service when necessary. Airfoil, backward curved and radial wheels available.

# "Buffalo" AIRFOIL FANS MEET EXACTING

Pacing the airfoil's rise to popularity for mechanical draft service, the "Buffalo" Airfoil offers many unique design and construction

- A completely streamlined inlet and matching wheel flange for completely smooth half-circle entry — no flat spots.
- Extra-wide airfoil blades with tips to full channel width — for extra-deep "bite".

TYPE "BA", the basic wheel design for mechanical draft applications.

TYPE "CA", for conditions of higher pressure and lower capacity.

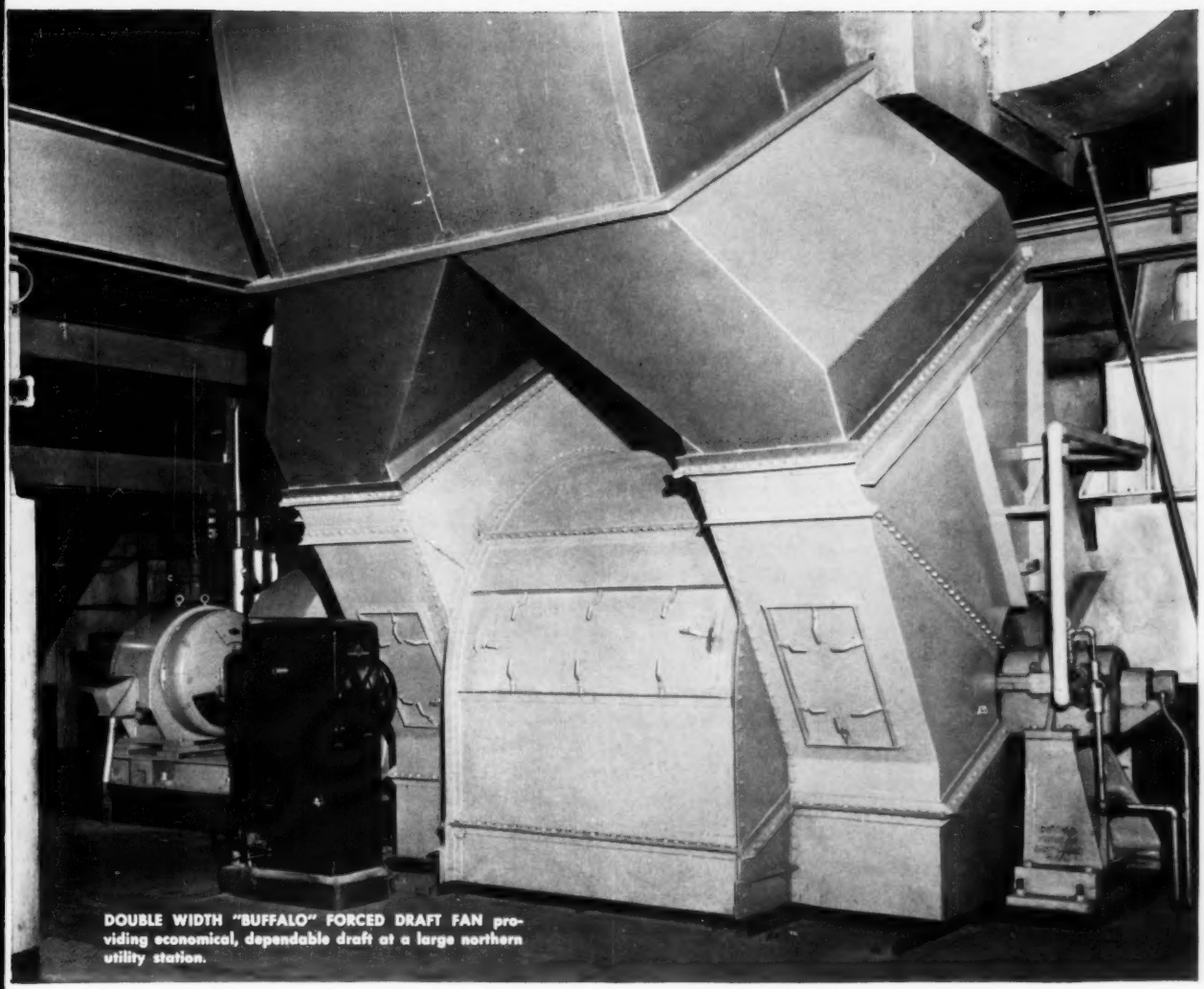
TYPE "AA", for lower pressures and higher capacities.

TYPE "CLM", one of 3 semi-airfoil wheels approaching performance of full airfoil wheels.

**THE COMPLETE "BUFFALO" AIRFOIL SERIES TO MATCH ALL SPECIFIC OPERATING CONDITIONS**

All wheels variable as to width for exact match of pressure-volume requirements with no sacrifice in efficiency. If you are interested in the finest draft service, write today for Bulletin FD106.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT



DOUBLE WIDTH "BUFFALO" FORCED DRAFT FAN providing economical, dependable draft at a large northern utility station.

# MECHANICAL DRAFT REQUIREMENTS

features found in no other fan. By combining modern fan engineering with traditional "Q" Factor* construction, "Buffalo" has given the industry an airfoil fan offering these important features:

- Strength and rigidity in the wheel — massive smoothly curved hub — heavy plate formed flanges welded to blades.
- "Buffalo" divergent outlet reduces outlet turbulence common to fans without such an outlet — provides smooth conversion from velocity to static pressure.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

## BUFFALO FORGE COMPANY

BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

# Reader service section

## *Start with these quick samples...*

**Stormy weather . . .**

both literally and figuratively speaking, plagues American & Foreign Power Co subsidiaries in Brazil and Costa Rica. The rainy season and nationalist-minded legislatures are making it tough on A & F Power's popularity and pocketbook. Meanwhile, in Australia, plans for an atomic research center in Sydney have hit a snag. Both stories . . .

**Reports from the field, p 144**

**Peak load generation . . .**

for a large utility system calls for gas turbines of a special sort. First paper in this month's collection of technical digests discusses the type of unit best suited for the application and describes its characteristics. As a service to its readers, *Power* keeps close tabs on the latest papers in the field, presents them in capsule form for fast reading.

**Technical briefs, p 146**

**Little wonder . . .**

Miniaturized dust collector, 1/10 to 1/20 the size of its contemporaries, shows an efficiency of 99%. Diesel air compressor serves remote areas unattended for 30 days. What will they think of next? Well, if you really want to know, better keep an eye on *Power's* plant equipment pages. They make good reading and provide a check on your plant's status.

**Plant equipment news, p 150**

**Its too hot . . .**

to spend time shopping around for new equipment. Let the manufacturer come to you and bear in mind that a manufacturer's best representative is his free literature. You don't have to keep any appointments—a bulletin can be laid aside and picked up at your convenience. The photos and terse descriptions give you all the information you'll need.

**Free literature, p 159**

**Fit as a fiddle . . .**

that's you. But are you sure? How long since you've dropped into your doctor's for a complete checkup? You wouldn't think of neglecting plant maintenance because you know that a little carelessness can cost lives. The same is true of personal maintenance. Care pays off in good health and peace of mind. Advice from your old friend . . .

**George Edwards, p 162**

***For other timely ideas, see following service pages▶***

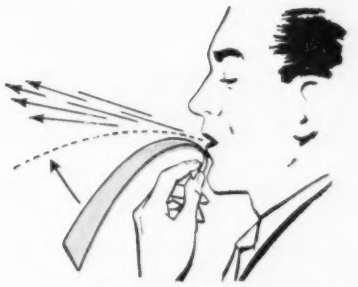
# ALL YOU NEED IS A STRIP OF PAPER!

See for yourself

**how this unique Sarco TD steam trap operates**

...why it's so simple...so trouble-free

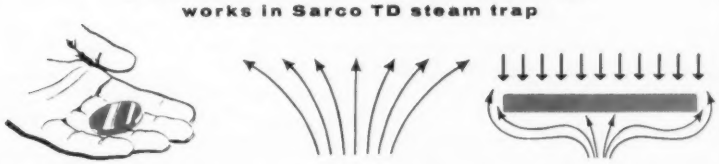
...so effective



***THE PAPER EXPERIMENT***

Hold a strip of paper (about 1⅜" wide by 7" long) directly under your lower lip. Blow — creating **low-pressure** area above the paper. It will be forced **upward** by atmospheric pressure, rising to horizontal position!

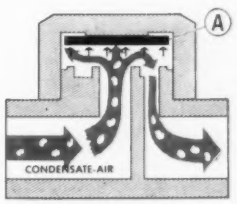
**SO SIMPLE—this is way same principle works in Sarco TD steam trap**



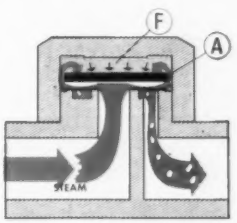
1. Substitute a simple Sarco valve disc for the strip of paper.

2. Substitute a high velocity jet of steam for the jet of air.

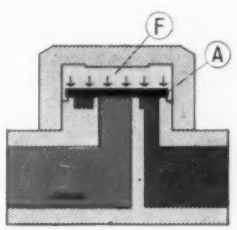
3. Direct steam jet across bottom of Sarco valve disc. This creates **low-pressure** area under disc—resulting in **downward** valve-closing force.




**A.** Inlet pressure raises disc "A" from seat . . . immediate discharge of air and condensate.

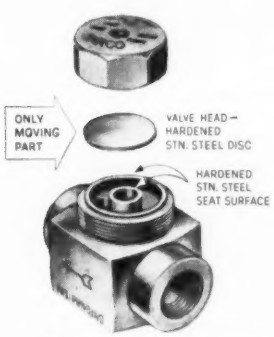



**B.** Steam follows condensate and the high velocity jet across bottom of disc "A" creates low pressure area (Bernoulli effect) . . . jet is deflected into chamber "F" where it builds up pressure by recompression and this pressure acts on top of disc "A" . . .




**C.** Pressure in chamber "F", acting on full top area of disc "A", exceeds force of incoming steam and low pressure area under disc . . . and immediately forces it down, closing inlet. As condensation decreases pressure in chamber "F", disc rises and steps **A** or **B** repeat.

*No other steam trap like it!* The Sarco TD embodies the most important advance in steam trap design in years . . . the thermodynamic principle. Introduced in 1953, the Sarco TD has been thoroughly service-proven. Thousands have been installed ... are providing a level of trapping efficiency and economy heretofore unobtainable.




**Small size . . . large capacity**

Only 3 parts . . . all stainless steel. Sizes ⅜ to 1"—each body is as small as a tee fitting! Capacity is determined not by a bulky body but by the effective orifice, valve action, pressure drop and condensate temperature.

**A FEW OF MANY ADVANTAGES**

- *Practically no maintenance*—no valve mechanism, no narrow channels. Trouble-free, simple design.
- *Cuts trap inventory*—one large capacity seat for all pressures . . . for heavy, light or no condensate load.
- *Self-adjusting for pressures 10 to 600 psi*—not a single change or adjustment required.
- *Operates perfectly when pressure fluctuates*—throughout full pressure range.

**See for Yourself**

We will gladly send you a Sarco TD Steam Trap and strainer for 60-day trial. No cost or obligation. You buy the TD *only* if you're completely satisfied. Advise size—⅜, ½, ¾ or 1"—and application. Sarco Company, Inc., Empire State Bldg., New York City.

2205-C

**SARCO Thermo-Dynamic STEAM TRAP**

THE MODERN TRAP THAT IS MAKING STEAM TRAPPING HISTORY!

# REPORTS FROM THE FIELD

***What's happening in power and what it means to you***

For Calendar of Events see page 210

## Stormy weather for A&F Power

**• Tropical legislatures and the weather are giving American & Foreign Power a bad time.**

**• Costa Rican and Brazilian subsidiaries are the trouble spots.**

A WISE OLD AMERICAN philosopher once remarked that you can't fight City Hall and officials of American & Foreign Power Co are having a hard time proving him wrong.

To make things tougher, the battle has to be waged on two fronts.

In Costa Rica, through its subsidiary, the National Power and Light Co, A&F Power has become engaged in a running public controversy with the government over a power shortage in the country. This is the story from McGraw-Hill's correspondent in San Jose.

Early in May, prior to the advent of the six-month rainy season, National Power and Light rationed electric power, thereby arousing a public clamor against the company. To explain its position, the company placed full-page ads in all local papers, claiming that inasmuch as the government would not permit the company to expand its power production facilities and since power purchased from government-owned and operated power production sources was inadequate, rationing was necessary. The company also warned that rationing would be even more severe at the end of the present rainy season unless additional power facilities become available.

The government, in turn, charged that N P & L was trying to discredit its program for nationalizing Costa Rican power production.

In any event, A&F Power finds itself in the highly uncomfortable position of being forced to explain to the public and customers why power will probably have to be sharply rationed again soon. And such explanations, indirectly at least, must be critical of the Costa Rican nationalized power program. Observers agree that, in a highly nationalistic country such as Costa Rica, this is a difficult position for a foreign-owned company to find itself.

And in Brazil, A&F Power is having more trouble.

Brazil's Chamber of Deputies has introduced a (*Continued on page* 216)

## Australia wants to be Asian atomic center

Melbourne (McGraw-Hill World News) —Plans are under way to bring into Australia a growing number of atomic scientists and engineers from Asian countries and to transform Australia into a regional center of atomic research with particular emphasis on peaceful uses of atomic energy.

One problem of importance in Australian plans to transform Sydney into an Asian-Pacific center of atomic research is the political criticism likely to arise over sharing atomic knowledge with Japan. Anti-Japanese sentiment is still exceptionally strong in Australia. On the other hand it is realized that Japan must be represented or else the plan will be worthless and Asian students will go to Japan rather than Australia.

Reports have it that a special body will be set up in the near future to coordinate research and to supervise relations between scientists and governmental authorities. The body will probably be known as the Australian Institute of Nuclear Science and Engineering. It is certain that its headquarters will be in Sydney, New South Wales, facilities at Lucas Heights.

## Power Lines

**Announcement** that John A Roebling's Sons Corp is nearing completion of $2.5 million installation of new production facilities for high voltage cable, comes from Charles R Tyson, executive vice president. Trenton, N.J. firm's expansion makes it possible to meet demands of utilities and construction industries for high voltage cable in lengths of 1000 ft or more.

**First shipment** of coal has moved to Eastlake generating plant of Cleveland Electric Illuminating Co after being pumped through world's longest coal pipeline. Operation of line is on a trial basis. Normal capacity will be about 1,300,000 tons of coal a year.

**Lightweight gas turbine** engine, weighing approximately 1/10 as much as industrial diesel or gasoline engines of comparable performance, is now under development by Army. Unit, with accessories, weighs 326 lb.

**Moscow played host** to world s electrical industry July 2-12. National committees of 32-country International Electrotechnical Commission were invited by U.S.S.R. National Committee to hold their annual conference in that city. The U.S. sent 24 delegates to the meeting from U.S. National Committee of the IEC.

**About 20 atomic power plants** will be built in East Germany by 1970, according to statement by deputy chief of East German office for nuclear research and nuclear technique. New plants will help to overcome increasing lack of coal in East Germany.

**Ministry of power** has given consent to construction of largest nuclear power station planned so far in Britain. Station will be located at Hinckley Point in Somerset, southwest England. Station will have two nuclear reactor furnaces each capable of 250 mw of electricity.

# Hall Industrial Water Report

VOLUME 5 AUGUST 1957 NUMBER 4

## Many Contaminants Can Get into Boiler Feedwater

The boiler is the sump in which all solids present in the feedwater must tend to accumulate. Normally, condensate returned to the boiler is relatively pure and the usual solids in the additional make-up water are handled routinely by chemical treatment and blowdown. When unexpected contamination of feedwater does occur, quick action is necessary to avoid serious trouble due to carryover, corrosion or tube losses. The Hall engineer is specially trained to help the plant operators locate the source of the contamination and get boiler water conditions back to normal.

### Get the Lead Out

When an eastern utility plant first opened a new high-pressure turbine, unexpected deposits were found on the blades in the reheat section. Even more unexpected was Hall Laboratories finding that the deposits were composed largely of lead silicate, an unprecedented constituent of such deposits.

A careful search for the source of the lead by plant engineers covered the entire boiler-turbine system and ended at the condenser. At start-up, considerable leakage had occurred between the condenser shell and tube sheets and between tube sheets and water boxes. When red lead compound was forced into the joints to seal the leaks, appreciable amounts had flowed between the tube sheets and shell into the steam space.

How did the lead get to the turbine? Slowly dissolving in the condensate, the lead oxide passed to the boiler in the feedwater, distilled off along with silica in the steam and deposited as lead silicate when decrease in temperature and pressure made the steam no longer capable of carrying it. Thorough cleaning of the steam space of the condenser was necessary to correct the problem.

### Diagnosis by Odor

Hall field engineer R. M. Jordan was called to a paperboard plant to solve a bad carryover problem which had developed because of contamination of the boiler water. A major clue was an odor of burned sugar throughout the plant and in the surrounding area.

Because of previous training and experience, Jordan's first question was whether any plant operation involved the use of starch. This led directly to the department where a starch base adhesive was prepared by indirect heating with steam. There a leak in the steam coil was found which had permitted siphoning of adhesive into the condensate line when the steam was shut off. Decomposition of the starch in the boiler resulted in foaming of the boiler water and in the odor of burned sugar in the steam.

### Raw Water Instead of Raw Carrots

When a foaming problem developed at an eastern food processing plant, the experienced operators looked for a leak at a kettle with resulting contamination of the condensate with some vegetable product. When they were unable to trace the problem to the usual sources they called Hall field engineer D. H. Pyle.

Pyle's first move was to analyze the boiler water. He found no phosphate even though a satisfactory amount had been reported shortly before the foaming started. Conductivity was very little greater than it had been earlier, indicating no great change in dissolved solids. However, the concentration of suspended solids was abnormally high.

The signs pointed to raw water contamination of condensate. Hardness determinations on the various condensate streams quickly revealed raw water leakage in a group of tubular water heaters. With this information the operators were able to stop the contamination and to get boiler water conditions back to normal in short order.

### Anti-freeze in Boilers

Late one afternoon Hall field engineer E. A. Ramalho received a call from a mid-western food processing plant in real trouble. Total solids concentration of the boiler water was far too high. Carryover was occurring. Despite increased feeding of phosphate and alkali, adequate concentrations could not be maintained in the boiler water.

Arriving at the plant, Ramalho had the operators give the boilers more blowdown and greatly increase phosphate and alkali feeding to maintain tolerable conditions in the boiler water until the source of the difficulty could be located.

Finding the point of contamination was not easy because of the large numbers of return lines and pieces of steam condensing equipment to be checked. However, Ramalho and the operators gradually narrowed down the search. Finally, in the wee hours of the morning, they found a leak in a small exchanger heating calcium chloride brine. Arrangements were immediately made to discard the condensate from this heat exchanger and further mopping up operations were easily accomplished.

### Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Division of Hagan Chemicals & Controls, Inc., Hagan Building, Pittsburgh 30, Pa.

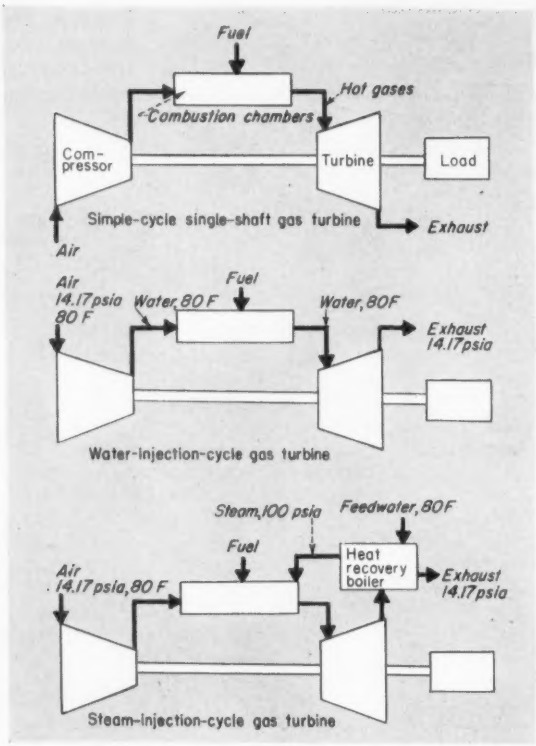
*Water is your industry's most important raw material. Use it wisely.*

**Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water**

# TECHNICAL BRIEFS

***Latest engineering developments for busy power men***

**13 papers for you on**
**GAS TURBINES**
**ELECTRICITY**
**LUBRICATION**
**ECONOMICS**




**THREE** gas-turbine cycle arrangements applicable to peaking service. All are variations on the simple-cycle turbine, *top*

## Gas turbines: peak load solution?

**Gas turbines for peak load generation on a large utility system.** *By W D Marsh and C M Wright, General Electric Co.*

In this paper the types of gas turbines best suited for peak load application are described and their characteristics discussed. A method of analyzing the economics of low cost peaking units on utility systems is presented, together with an example of gas turbine application to a typical large utility.

The characteristics of an electric generating unit best suited to peaking service are (1) low installed cost (2) low operating labor cost (3) quick starting (4) low standby cost (5) low maintenance.

Gas turbines have extreme flexibility of cycle arrangement which can be made to best meet the requirements of a particular situation. Cycle arrangements in successful service vary all the way from the simple-cycle single-shaft to the cross-compound intercooled, reheat, regenerative cycle. Efficiencies are, in general, comparable to the cycle complexity and range from about 18 to 30% thermal efficiency, based on the higher heating value of oil fuel.

Conclusions reached include the following: (1) Gas turbines combine the advantages of low investment with ideal characteristics for peak load operation. (2) The cost of gas turbine peaking stations varies with differing local conditions. (3) In areas where the most economical fuel is coal, gas turbines must burn relatively expensive oil, which tends to make the fuel cost disadvantage greater than in areas where gas or oil is the economical steam plant fuel. But the higher investment cost of coal-fired steam plants gives a greater investment saving which in many cases will more than offset the fuel cost disadvantage. (4) In addition to investment savings, gas turbine generating stations permit important operating labor cost savings. *APC paper, No number.*

**A new single-shaft 3000-hp gas turbine ideal for mechanical drive application.** *By J Yindra, Westinghouse Electric Corp.*

Design and construction of a new 3000-hp single-shaft gas turbine that has been designed for sufficient speed flexibility to make it ideal for mechanical drive applications is described in this paper. Overall performance and efficiencies are presented, together with a description of the control system and its application to variable-speed drives.

Shop tests have confirmed that the turbine has met design expectations for efficiency, load capability and speed-load characteristics.

The increased use of high-speed direct-driven centrifugal compressors and pumps, together with the requirement of small compact packaged-power generating plants, has prompted this new design of gas turbine. The unitized mechanical design packages the entire power plant, including the driven equipment, thereby reducing cost and time for a complete power plant installation. Features of this plant will result in a low installed first cost making this type unit most economical for many industrial applications. This unit offers industry a power plant in a rating that fills the gap in optimum size between the small reciprocating engine and the large steam turbine. *ASME paper, No. 57-GTP-12.*

**Gas turbines for the chemical industry.** *By Z S Stys, Brown Boveri Corp.*

The application and satisfactory operation of the gas-turbine cycle, especially in combination with the isotherm compressor, opens a new field for this prime mover in chemical pro-

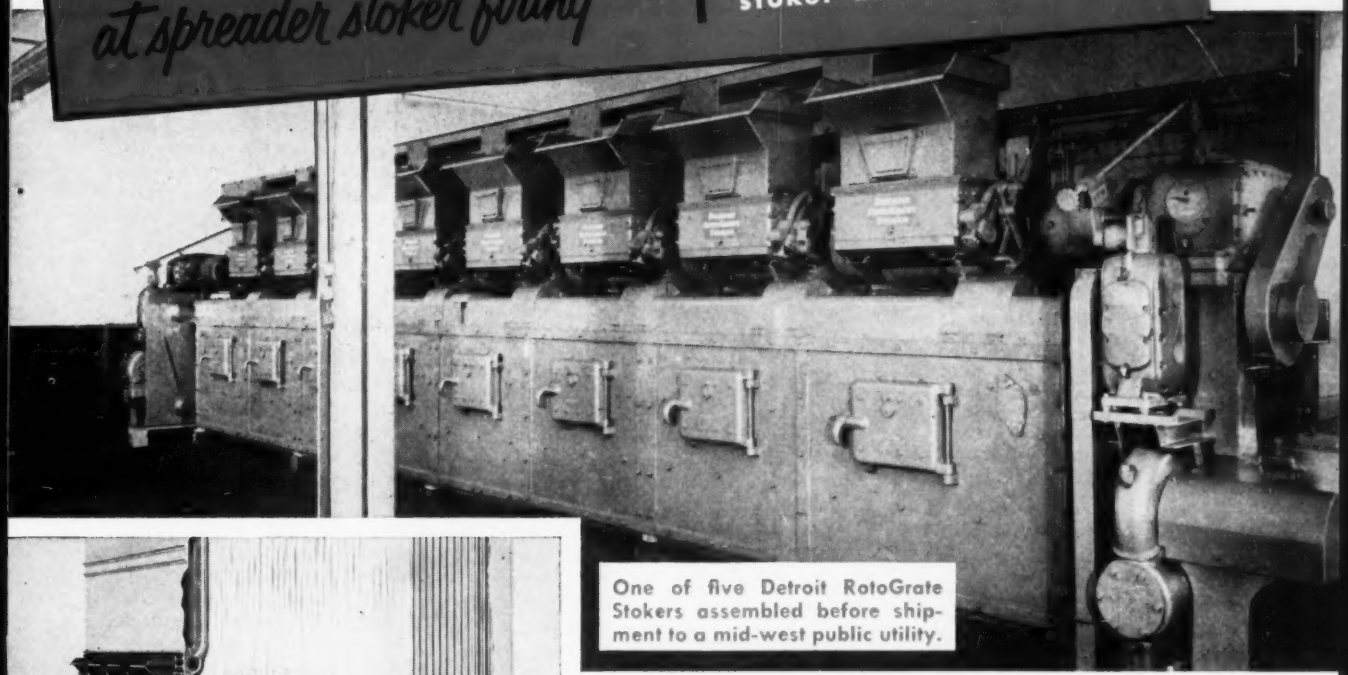
(*Continued on page* 148)

# Let's take a NEW LOOK at spreader stoker firing

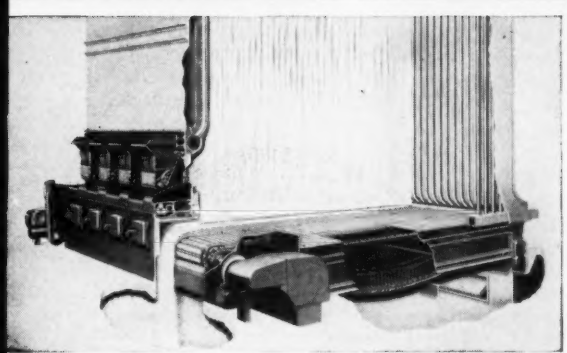
particularly

## DETROIT ROTOGRATE

stoker advantages



One of five Detroit RotoGrate Stokers assembled before shipment to a mid-west public utility.



**Detroit RotoGrate Stoker with two of the six Rotors removed to show the overlapping highly restricted grate designed especially for spreader stoker firing.**

- **High Burning Rates** per square foot of grate area permit continuous operation with less expensive boiler and furnace design
- **Low Carbon Loss** results in high over-all efficiency
- **Superior Design** permits operation with low excess air
- **Wide Load Range** handled smokelessly with convertible grate area
- **Low Maintenance** compared to other coal-burning methods.
- **Burns All** bituminous coals and Lignite. Also bark, wood, bagasse and other refuse fuels, either separately or in combination with coal

• Contact our nearest District Office or your consulting engineer.

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## DETROIT STOKER COMPANY

**Main Office and Works • Monroe, Michigan**

**District Offices or Representatives in Principal Cities**

# More TECHNICAL BRIEFS

Begins on page 146

cessing. There are still more fields in the chemical industry where similar applications can be efficiently applied. Where the pressure is high a booster compressor can be used.

The gas turbine is not limited to use with air or nitrogen, but can be used with any gas. Therefore the author believes that a gas-turbine cycle will establish itself in other chemical processes as it has in the ammonia-oxidation process. *ASME paper, No. 57-GTP-9.*

**Influence of working-fluid characteristics on the design of the closed-cycle gas turbine.** *By S T Robinson, American Turbine Corp.*

During the past few months there has been a renewed expression of interest in the high-temperature gas-cycle reactor coupled with a closed-cycle gas turbine in a single loop as a way to use the energy available from nuclear fission. Two closed-cycle gas-turbine plants are planned in this country, both suitable for use with a gas-cycle nuclear reactor as a heat source. These plants differ widely in output, purpose and nature of the working fluid.

This paper reports some of the results of a study on the effect of the nature and characteristics of the working fluid on the design of the non-nuclear components.

Within the limits of this study, it does not appear that the nature of the working fluid has any significant effect on power plant efficiency. It is possible to build a helium compressor of acceptable dimensions and performance within the present state of the art. *ASME paper, No. 57-GTP-13.*

## Electricity

**New 13.8-kv 750-mva metalclad switchgear with magnetic type power circuit breakers.** *By J G Torbit and E M Troischt, General Electric Co.*

Metalclad switchgear with magnetic type power circuit breakers in voltage ratings of 13.8 kv and below, and with interrupting ratings from 50 to 500 mva, has been available since about 1945. The top interrupting rating of 500 mva was generally sufficiently high for the majority of applications. But in the early 1950's, the 500-mva rating began to become a limitation. Rapid expansion and growth of industrial plants required increasing concentrations of power. Larger metropolitan area substations were indicated by the increasing load density, congestion and high cost of real estate for substation sites.

Development work on 750-mva metalclad equipment and magne-blast circuit breaker was started at the conclusion of studies, and the first equipment of this rating was shipped during the first quarter of 1956.

Paper describes the equipment and test results. The assembly follows many of the principles and practices of previous designs of lower rated equipment. It also includes important changes and improvements required to insure reliable trouble-free performance in the field. *AIEE paper, No. 57-180.*

**A motor-powered stored-energy operating mechanism for magnetic type power circuit breakers in metalclad switchgear.** *By E T McCurry and J A Favre, General Electric Co.*

A motor-powered stored-energy operating mechanism is suitable for general application and is an ideal answer for installations where it is desirable to provide only a limited source of ac or dc closing power. Thus, it is possible to dispense with the relatively large operating battery or control power transformer and the closing rectifiers that would otherwise be required for closing. This is particularly important in installations with only a small number of circuit breakers, as well as in larger installations where the simultaneous closing of a number of breakers may be necessary. Such a stored energy mechanism has inherent ability for high-speed closing and reclosing without requiring a high value of instantaneous closing power for charging or closing.

Also, such a design is well-adapted to the manual release of the stored energy for closing the breaker in the temporary absence of electrical closing power, as well as to permit manual charging. This emergency manual closing feature, not inherently obtainable from a solenoid closing mechanism, is often desirable and many times even necessary.

The new mechanism will close and latch magnetic-type breakers with momentary current ratings up to and including 60,000 amp in voltages from 4.16 to 13.8 kv and in interrupting ratings from 150 to 750 mva, inclusive. Operating force for the mechanism is supplied by a high speed ½-hp gear motor. Energy from the motor is stored in powerful springs that are capable of closing the circuit breaker at its required speed under all conditions. Only after the mechanism is fully charged can it be released to close the breaker. As soon as the circuit breaker has been closed by the mechanism, the motor immediately recharges the springs. The spring charging time of five seconds and the fast circuit breaker closing time of six cycles or less provides ample time margin for all normal duty cycles. *AIEE paper, No. 57-181.*

## Lubrication

**The fluid dynamic theory of gas-lubricated bearings.** *By J S Ausman, Garden Grove, Calif.*

Although it has long been recognized that gases as well as liquids can be used as lubricants in fluid-dynamic bearings, there have been few attempts to exploit the advantages of gas-dynamic bearings. A Kingsbury, in 1896, constructed a self-lubricating gas journal bearing for exhibition purposes. He made a considerable number of experimental measurements to determine its characteristics. A few journal bearings of similar design are currently being used on experimental rotating electrical equipment like generators, converters and induction motors. One possible reason that gas bearings are not more widely used is that, in its present state, the theory is cumbersome and its applicability limited.

The author derives a differential equation for the pressure-distribution in gas-lubricated slider bearings from the basic equations of fluid mechanics. The equation is an extension of Harrison's gas-bearing equation in that the infinite width and isothermal restrictions have been removed.

A perturbation solution is proposed and is carried out for the special case of an infinitely wide, self-lubricating journal bearing. Comparisons with numerical solutions to Harrison's equation indicate that the first three terms in the series solution are sufficient to determine the pressure distribution and bearing load with reasonable accuracy. *ASME paper, No. 56-LUB-6.*

**Experiments on gas-lubricated journal bearings.** *By M Wildmann, North American Aviation.*

In applications such as instrument bearings, load capacity is often a sec-

(*Continued on page* 218)

Directions for ordering papers on p 222

# CHECK HIDDEN FEATURES of Allis-Chalmers Individually Enclosed

# LOW VOLTAGE BREAKERS

## *Safe, Easy to Inspect . . . Simple, Easy to Mount*

**1.** Easily accessible — Removal of deep front cover permits inspection and maintenance of breaker from front or sides.

**2.** Easy breaker removal — Pull-out construction permits removal without disconnecting cables. Cable connections are accessible through entire front opening.

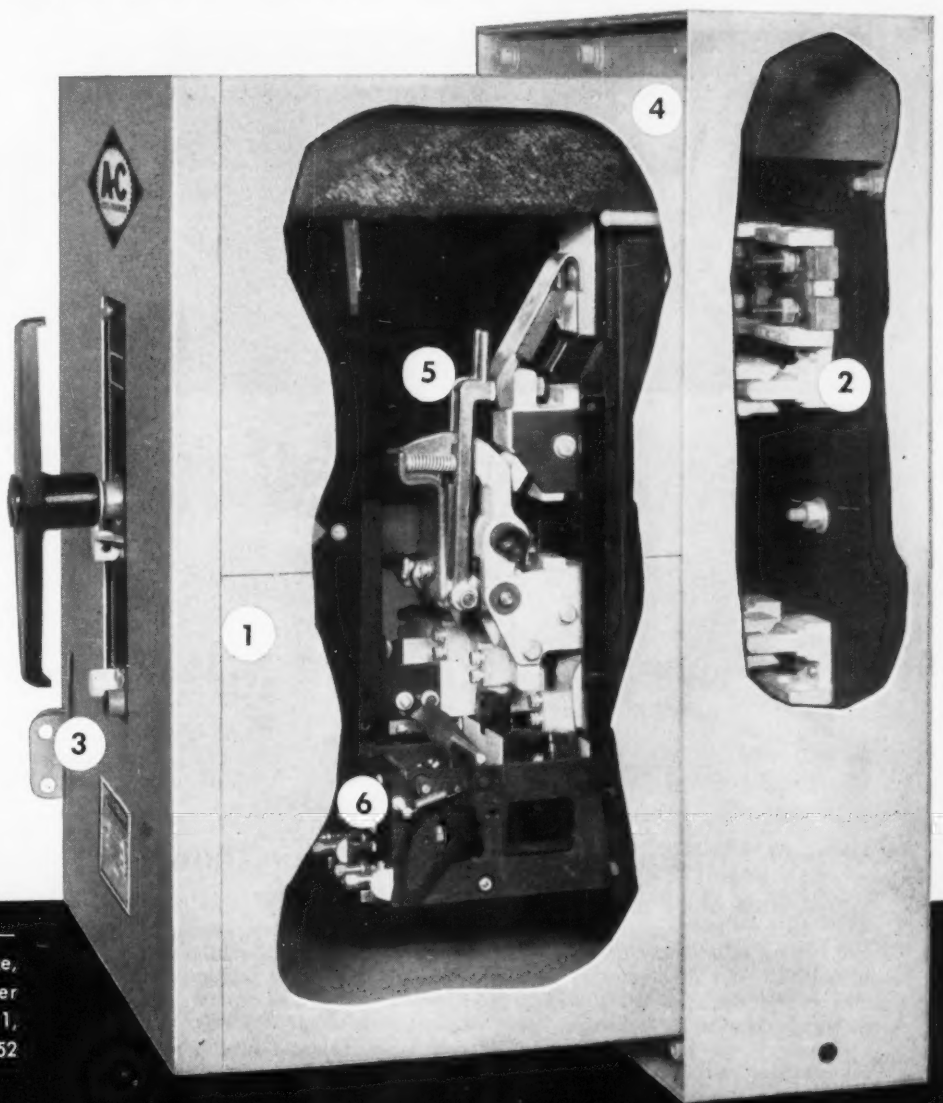
**3.** Safety Interlock — Prevents removal of cover while breaker contacts are closed.

**4.** Enclosures to meet your needs — Weather-proof or dust-proof as well as standard general purpose enclosures are available.

**5.** Long life contacts — There's no bounce—less erosion — due to high contact pressure with blow-on type action.

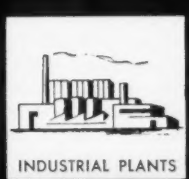
**6.** Accurate time-delay control — Hermetically sealed, positive displacement trip device is used.

*For service to 600 volts ac, 1600 amperes continuous, 50,000 RMS amperes interrupting at 600 volts ac.*




Get details, dimensions, prices — Contact your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletins 1B8252 and 1B8283.

PUBLIC BUILDINGS


INDUSTRIAL PLANTS

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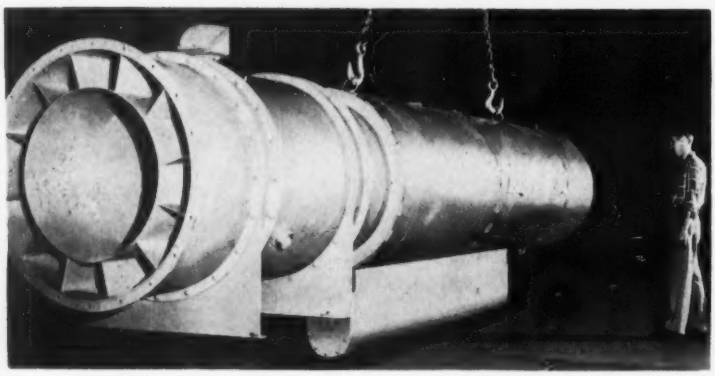
# ALLIS-CHALMERS

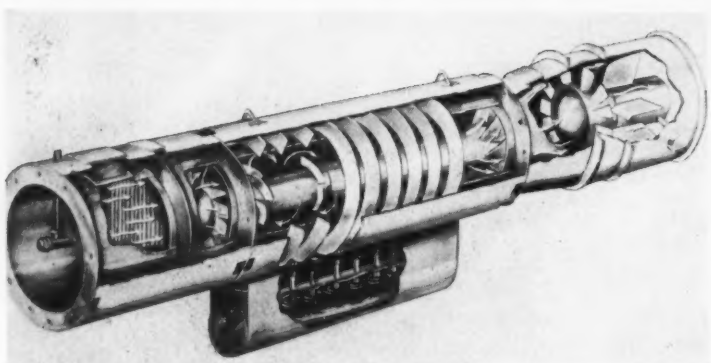
A-5220

# PLANT EQUIPMENT NEWS

***Your information center for new products designed to solve plant problems***

Published monthly as a service to readers





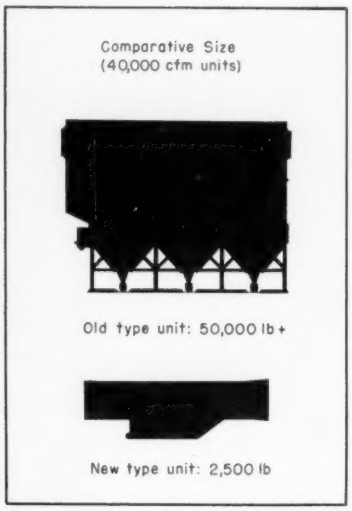



**CHART** *above* compares size of old and new type dust collector, while photo *top left* shows unit assembled and ready to go. Photo *bottom left* traces process of contaminated air. Air enters unit's mixing section which contains water spray and impingement element; goes next to water elimination section—an axial type cyclone with turning and straightening vanes; third stop is the transition area

## Miniaturized dust collector shows 99% efficiency

**801** • Industry has been offered a new tool for dust collecting chores with the introduction and demonstration of a dust collector described as 1/10 to 1/20 the size of comparable equipment.

Unit is a wet, inertial type which manufacturer claims has an efficiency greater than any comparable wet-type collector. Manufacturer cites figures which show that unit has an efficiency of 99+% in collecting dust particles of five microns or greater.

Prototype models have already been tested under actual working conditions at several locations in the U.S.

Spokesmen for manufacturer report that unit is unique in being the first commercial dust collector which embodies all the fundamental principles of the *Greenberg-Smith Impinger*, long used as standard dust measuring instrument by U.S. Public Health Service.

Real impingement is said to occur only when dust and its carrying air impinge at high speed (4500-6000 lineal ft per min) against a film of water. This happens in the mixer section of the unit.

Unit is a cylindrical device having two essential parts: a mixer section and an eliminator section. Dust-laden air or gas enters unit at its mixer section. Here impingement takes place. Each dust particle is enveloped in water as it passes through a fine spray.

Air and entrained water-enveloped dust pass through turning vanes as they enter the eliminator section. These vanes impart a helical motion which causes a centrifugal force. This force dynamically separates the entrained particles from air. Dust-laden water is captured at periphery of the eliminator section in blind louvres which are connected to a disposal sump at unit's bottom.

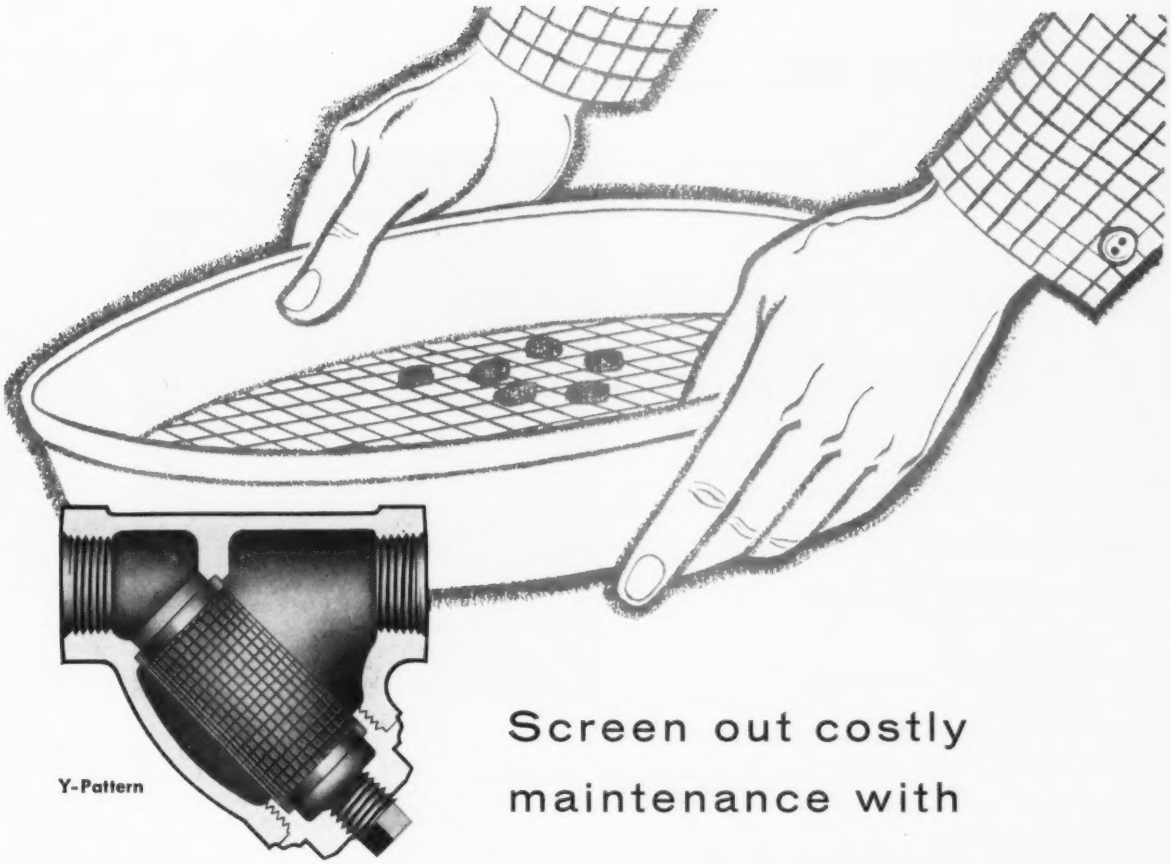
Cleaned air passes out of the eliminator section through straightening vanes which recover energy of rotation thus reducing over-all gas loss.

If sufficient pressure to drive gases is not available ahead of unit, a vane-axial fan may be attached at rear.

Unit can be mounted in existing duct work at point of use. Space and installation economies to be realized because of this are said to be considerable. Details from manufacturer.

**Joy Manufacturing Company**
**Oliver Bldg, Pittsburgh 22, Pa.**

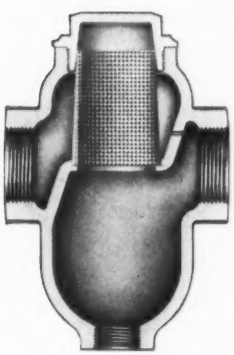
For more data on these items, use post cards on page 159. Identify your request with item number



Y-Pattern

Screen out costly maintenance with

# CRANE SEDIMENT SEPARATORS



Vertical Types

Crane Sediment Separators positively and automatically trap foreign matter in fluid handling lines—steam, water, air, oil or gas, high or low pressure—and hold it for easy removal.

Dirt, scale, sand and other injurious particles are prevented from damaging or spoiling product and ruining valve seats, automatic devices and other delicate equipment.

Because of their exceptionally large screening areas—more than 500% greater than pipe area—Crane Sediment Separators assure unrestricted flow of product, even when partially plugged. Note special blow-off connection for drain valve attachment which permits easy cleanout without interrupting flow service.

**LITERATURE SENT ON REQUEST**

Available in both Y-patterns and vertical types, with full range of capacities and sizes. For literature on Crane Sediment Separators, see your Crane Representative or write to address below.

# CRANE VALVES & FITTINGS

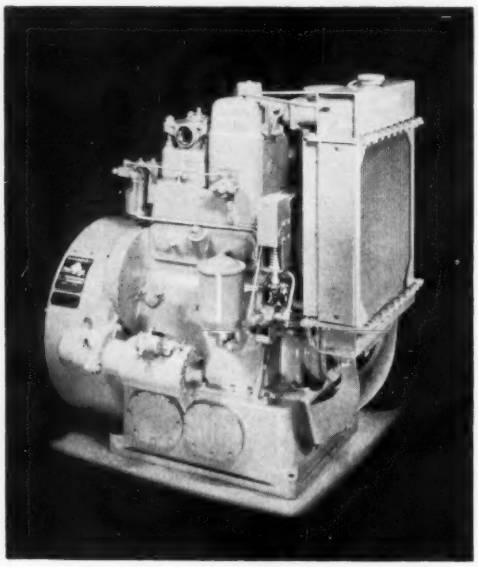
**PIPE • KITCHENS • PLUMBING • HEATING**

*Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas*

# More EQUIPMENT NEWS

Begins on page 150

## Diesel air compressor serves remote areas, unattended, 30 days



**802** • Automatic diesel air compressor unit has a capacity range of 30 cfm at 60 psi delivery and 26 cfm at 100 psi delivery. Unit is designed for service in remote areas where commercial power is not available.

Unit consists of a two-cylinder diesel engine, which has one diesel cylinder converted to an air compressing cylinder. Diesel cylinder head is replaced by a compressor cylinder head but piston and rings are unchanged.

Concentric-type compression valve which combines both suction and discharge in a single unit, is incorporated in the head. This all-hardened steel valve provides a minimum amount of volumetric clearance in the cylinder and a great degree of accessibility. For example, the entire plate valve assembly can be removed without disturbing any cooling water connections or the discharge air hose.

Unit operates at 800 rpm and large radiator has sufficient capacity for effective operation at ambient temperatures of 125 F. Thermostat maintains jacket water temperature at 180 F, according to manufacturer, even with light loads. Since frame is designed to withstand diesel pressures, there is a considerable safety factor for air compressor operation.

Control unit monitors lubricating oil pressure, jacket water temperature, compressed air volume and engine starting-battery charging circuit. If any one of these exceeds an established safe range, controls will stop engine and start standby unit.

**Automatic Power, Inc**
**205 Hutcheson St, Houston 3, Texas**

### Pumps suited to boiler-feed service

**803** • Diagonally split case centrifugal pumps are said to be suited to many applications. Among these applications is boiler feed service as well as hot or volatile liquid applications requiring low NPSH characteristics.

According to manufacturer, these pumps, while retaining the advantages of the horizontally split case pumps, embody advantages inherent in the 45-deg casing split. The features in common with horizontally split case pumps are: ability to remove the entire rotating element without disturbing piping or the pump-motor-base alignment. The 45-deg split allows both suction and discharge to be in the bottom half of the casing but above the center line of the pump.

Units are self-venting and will not vapor-lock, says manufacturer. Thus, the need for bleeding back to the feedwater heater or the receiver is eliminated. Large suction areas are said to give ideal NPSH characteristics. Request details.

**Aurora Pump Div, The New York Air Brake Co**
**47 Loucks St, Aurora, Ill.**

### Pumps suited to acid-handling duty

**804** • Glassed centrifugal pump is said to be completely inert to all common acids except hydrofluoric. Even at high temperatures, says manufacturer, all acids except hydrofluoric and concentrated phosphoric leave working surfaces unaffected. Glass surfaces of pump are also said to be immune to the corrosive action of all alkalis up to pH 12 and temperatures up to 212 F.

Glass is permanently fused to metal pump parts so that glass and metal interlock mechanically and form an inseparable bond. Because of interlocking action of glass and metal at fusion temperatures, fractures will not run, says manufacturer. Therefore, sharp mechanical impact can cause damage only at point of impact.

Unit is available for heads up to 140 ft and is built in 4 sizes with capacities up to 700 gpm. Suction piece, casing and casing cover are all glassed where there is liquid contact. Impeller is glassed on all sides. Request details.

**Goulds Pumps, Inc, 32 Black Brook Rd, Seneca Falls, N. Y.**

For more data on these items, use post cards on page 159. Identify your request with item number

*GAS CLEANING NEWS*

# Eastern Public Utility Installs Two More Koppers Electrostatic Precipitators to Remove Fly Ash

## Major Utility has installed 8 Koppers Electrostatic Precipitators since 1947

YEARS of cost-saving, highly efficient performance preceded this latest installation of Koppers Electrostatic Precipitators. During these years, this leading Eastern public utility was able to judge Koppers by on-the-job operation—the most positive proof of performance.

**Proves Performance on the Job**

Ten years ago, this company purchased its first two Koppers Electrostatic Precipitators for fly ash removal. Satisfactory performance and low maintenance costs justified the purchase of additional Koppers units that were installed in a total of 4 stations. The eight units furnish highly effective, trouble-free operation in a varying range of CFM capacities.

**Supplies a Wide Range**

The eight Koppers Electrostatic Precipitators serve boilers ranging in capacity from 570,000 #/hr to 950,000 #/hr. Guaranteed efficiency runs as high as 98%, depending on the need of each application. This ability to engineer for a wide range of capacities enables Koppers to satisfy the needs of each station.

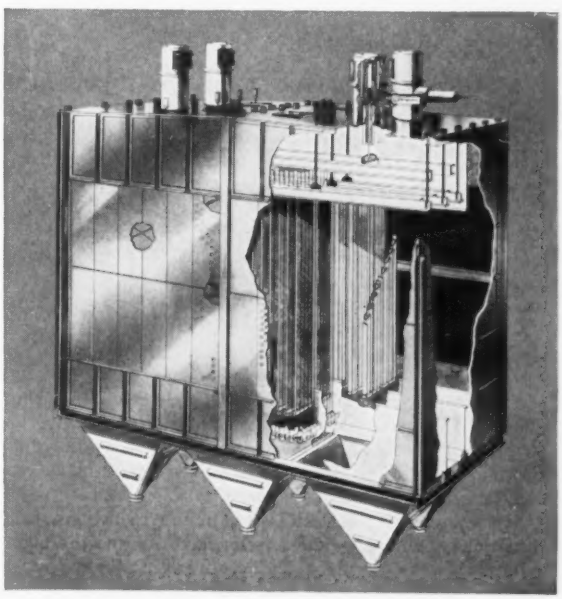
**Meets Individual Plant Needs**

Koppers custom-designs each Electrostatic Precipitator. Koppers units remove boiler fly ash before the flue gas is discharged from the stack. In designing Electrostatic Precipitators, Koppers utilizes its knowledge of the characteristics of various coals, types of boilers and methods of firing.

**Backed by Know-How**

Koppers gas cleaning experience goes back 75 years. This experience is backed up by extensive research facilities at Verona, Pa., and Baltimore, Md. From this experience and research has come gas cleaning equipment for all sizes and types of plants.

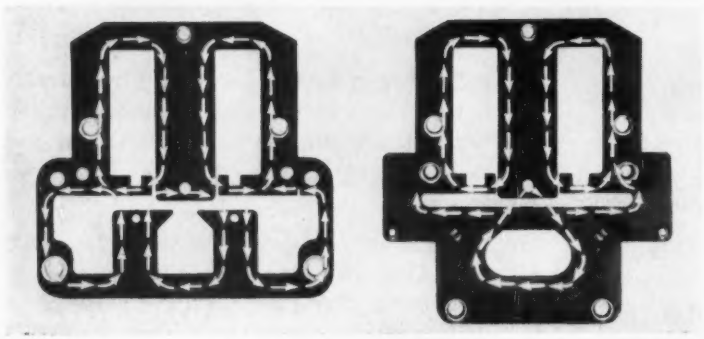
Get the most out of your gas cleaning dollar. Write KOPPERS COMPANY, INC., Metal Products Division, Industrial Gas Cleaning Dept., 4808 Scott Street, Baltimore 3, Maryland.



This cutaway photo of a Koppers Electrostatic Precipitator shows shell, vibrators, and collecting and discharge electrodes. The actual design and arrangement of elements vary widely because Koppers Electrostatic Precipitators are custom-engineered to fit the requirements of each installation.

# More EQUIPMENT NEWS

Begins on page 150



**OLD STATOR** has a single core to accommodate voltage and current fluxes

**NEW STATOR** eliminates undesirable intermingling of voltage and current fluxes

## Watt-hour meter has "on-line" accuracy to 200 amp

**805** • New stator design of this watt-hour meter is claimed to permit "on-line" accuracy up to 200 amp. The meter, called the I-60, is a 30-amp 240-volt 3-wire single-phase model, with an overload capacity of 667%.

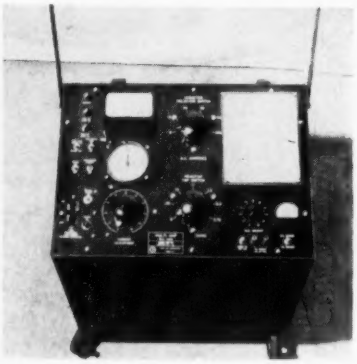
Load curve of the I-60 is claimed by manufacturer to be the closest anyone has come to on-line accuracy over such a wide load range in a single-phase watt-hour meter. Accuracy is not only "right-on" at full and light load test currents of 30 and 3 amp respectively, but is still on at 15 and 1.5 amp, the test currents for a 15-amp meter.

At heavy load end of the curve, manufacturer says, the I-60 is within three-quarters of 1% at a full 200 amp.

New stator design makes the light load accuracy of the 30-amp I-60 comparable to the performance of a 15-amp meter. In the new stator, the conventional combined voltage and current electromagnet is replaced with a pair of magnetically isolated electromagnets, one for voltage and one for current, drawing, above. This design is said to overcome many compromises formerly necessary in core design, material selection and current coil configuration. It also minimizes potential losses, torque reductions, coil balance errors at heavy loads and a low power factor, according to the manufacturer.

Butyl-insulated current coils move freely on the current laminations without affecting meter calibration. This eliminates calibration errors resulting from gap distortion caused by socket forces transmitted through the current leads.

**General Electric Company, 1 River Road, Schenectady 5, New York**

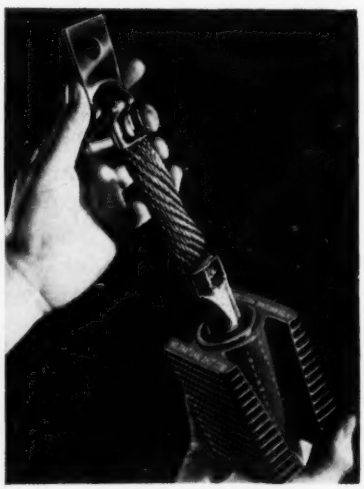


### Portable test set

**806** • Unit is applicable in any large industrial plant for testing over-current relays, motor overload relays voltage relays, complete switchgear timing, throw over schemes, etc.

Output current is accurately adjustable in six ranges from 100 amp at 10 volts to 2 amp at 500 volts.

**Multi-Amp Corp, 465 Lehigh Ave P.O. Box 217, Union, N. J.**



### Power rectifier junctions

**807** • Series of low current density, high-capacity germanium junctions are rated at 330-amp rectified output current at voltage ratings from 20 to 66 volts rms. Units feature corrosion and moisture resistant cast-aluminum housings with airfoil type cooling fins for maximum heat dissipation. Efficiency to 98.5% and small unit size are claimed advantages. Six 330-amp germanium junctions connected in 3-phase bridge circuit will deliver 85 kw, and occupy only ½ cu ft of space.

**International Rectifier Corp E Grand Ave, El Segundo, Calif.**

For more data on these items, use post cards on page 159. Identify your request with item number

# EDISON'S OMNIGUARD

## CONTINUOUS TEMPERATURE MONITORING EXTENDS SLEEVE BEARING LIFE

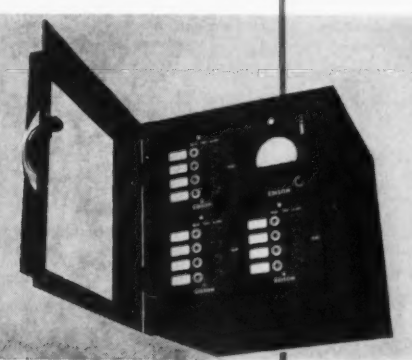
Sleeve bearings are a critical factor in the output of any continuously operating plant. An increase in temperature of **only 20°F** above 180°F cuts bearing life almost in half; hot-running bearings can lead to costly maintenance and downtime.

The Edison Omniguard Temperature Monitoring System, inherently sensitive to minute temperature changes, simultaneously alerts an operator or attendant when even the smallest temperature change occurs. This means that not only can dangerous bearing temperatures be detected well in advance of emergency conditions, but bearing life is greatly extended.

A small plug-in control box and resistance temperature detectors comprise the entire multi-point thermometer system. There is no scanning mechanism to delay the warning signal, few moving parts, no electronic tubes, and no costly circuitry. One **simplified** system eliminates the inaccuracy, danger and expense of attendants checking bearing temperatures by hand.

Omniguard is in use in thousands of installations continuously improving plant operation and lowering maintenance costs for production personnel from coast to coast. Write today for complete technical information.

McGRAW EDISON



**LOW COST MODULAR UNITS**

THE BASIC OMNIGUARD SYSTEM COSTS LESS THAN ANY OTHER TEMPERATURE-MONITORING SYSTEM.

**Thomas A. Edison**
INDUSTRIES
INSTRUMENT DIVISION
WEST ORANGE, N. J.

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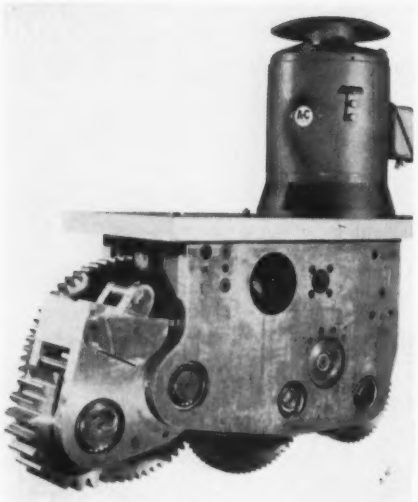
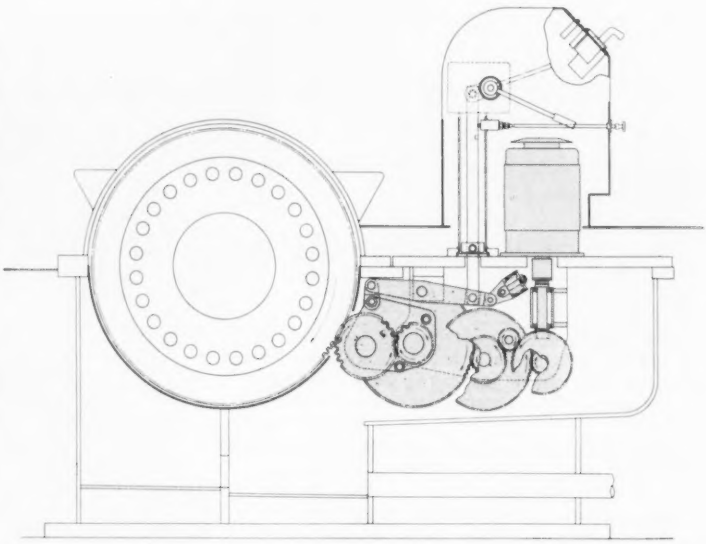
Begins on page 150





## Turning gear stays in place during large turbine servicing

**808** • Underslung two-speed turning gear has been developed for steam turbine generator units 100 mw and above.

Designed directly into one of the turbine pedestals, this device rotates the spindles of these 1000- or 1050-F turbines during preheating, rolling or cooling periods. Not only does this keep the spindles uniformly heated circumferentially but also the casings, due to agitation of hot vapors. Diametral temperature gradients of these parts are thereby kept low to avoid distortion, according to manufacturer.

The new turning gear is built into the pedestal at the side of the turbine center line. Claimed advantage of this setup: neither the gear nor its covering control console need be removed or disconnected when the unit is being serviced.

Gear's two speeds are obtained by using a single-speed reversing motor. Two free-wheeling clutches connect it to two gear trains to provide three rpm for starting and a higher rpm for rolling. The drive pinion is manually engaged when the unit shaft is at rest. It disengages automatically as the shaft accelerates with steam.

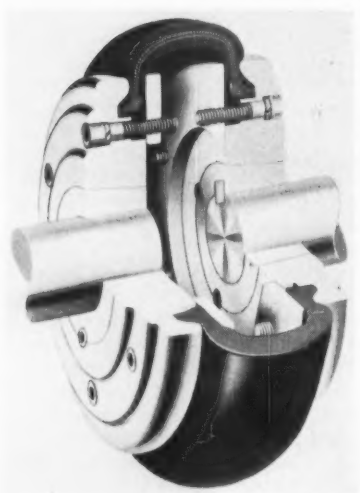
On cross-compound units, the underslung turning gears on the two shafts perform the additional function of establishing shaft speed ratios preparatory to synchronizing them electrically.

Drawing, above right, shows unit's location in relation to the turbine shaft. Further details from manufacturer.

**Allis-Chalmers Manufacturing Co, Milwaukee 1, Wis.**

For more data on these items, use post cards on page 159. Identify your request with item number

## Flexible cushion coupling features rubber tire



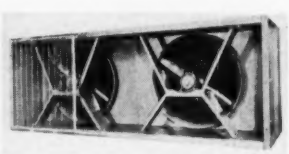
**809** • *Para-flex* coupling handles angular misalignment, parallel misalignment and end-float, and in any combination according to manufacturer. Flexible member also cushions shock loads and diminishes torsional vibration.

Heart of unit is a tire with synthetic tension members bonded together in rubber. This tire is clamped between two hubs which are mounted on shafts to be coupled. Flexible member is held between flanges and clamp rings of the hubs. The tire has a transverse split molded into it to permit installation and replacement without moving driver or driven machine.

The couplings are available in capacities up to 600 hp at 900 rpm.

**Dodge Manufacturing Corp**
**Mishawaka, Indiana**

**Don't miss this item . . .**



**Industrial heat exchanger** p 164

**. . . or other product news appearing on following pages**

**Lift check valve** . . . . . p 164
**Expansion joints** . . . . . p 166
**Corrosion inhibitor** . . . . . p 168
**Adjustable motor base** . . . p 170
**Vacuum ball valves** . . . . . p 172
**Pneumatic drive units** . . . . p 174
**Diaphragm pumps** . . . . . p 176

# Neodesha packs 1-2 performance punch

## 1 | *Nordberg Diesels* 2 | *STANODIESEL Oil M*

Operator J. N. Finkinbinder (left) and Everett Powell, Neodesha Superintendent of Electric and Water Plants, adjust rocker arm assembly of Nordberg Duafuel Engine. Engine operated 40,431 hours before overhaul, carrying about 90% of load. All engines in service at Neodesha are Nordberg's. All use Standard Oil's STANODIESEL Oil M.

Finkinbinder and Powell inspect oil filter used for filtering STANODIESEL Oil M used in all six Nordberg Diesels at Neodesha, Kansas, power station.

### *Quick facts about* STANODIESEL OIL M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by using economy fuels.
- Maintains film on difficult to lubricate parts.
- Eliminates spark plug fouling in spark-ignited gas engines and reduces combustion chamber ash and deposits in engines burning natural gas, LPG and liquid fuels.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.

The city of Neodesha, Kansas, has six Nordberg engines in service. They have operated more than 400,000 hours on Standard Oil diesel lubricating oils. Here is the case story of one of these engines. The performance of this engine is typical.

In 1952, the city of Neodesha installed a 1,750 hp., 1230 kw., Nordberg Duafuel engine. During the period between February 14, 1952, when the engine went into service, and March 1, 1956, the engine ran 34,370 hours out of a possible 35,784. This is 96% of the engine's total installed hours. In this time, not even a piston or cylinder head was removed. So good was the performance of this engine using STANDARD HD Oil that when Standard introduced an improved diesel oil—STANODIESEL Oil M—in February, 1955, this engine was converted to this new oil.

**There is more to the story.** The engine continued in service to 36,223 hours when No. 7 cylinder liner was pulled to put rubber gaskets on liner to stop water leakage. At this time, No. 7 piston and liner were checked. Liner wear averaged only 0.0045 inches. The top ring showed an average wear of 0.016 inches. The No. 2 ring was 0.020 inches. Little, if any, wear was indicated on other rings. Now, at 40,431 hours, the engine is down for overhaul of turbocharger and to have valves ground. Bearings were found in excellent condition. No pistons are to be pulled.

**Get more facts** about STANODIESEL Oil M by calling the Standard Oil office near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Illinois.

STANDARD

**STANDARD OIL COMPANY**
(Indiana)

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two wires
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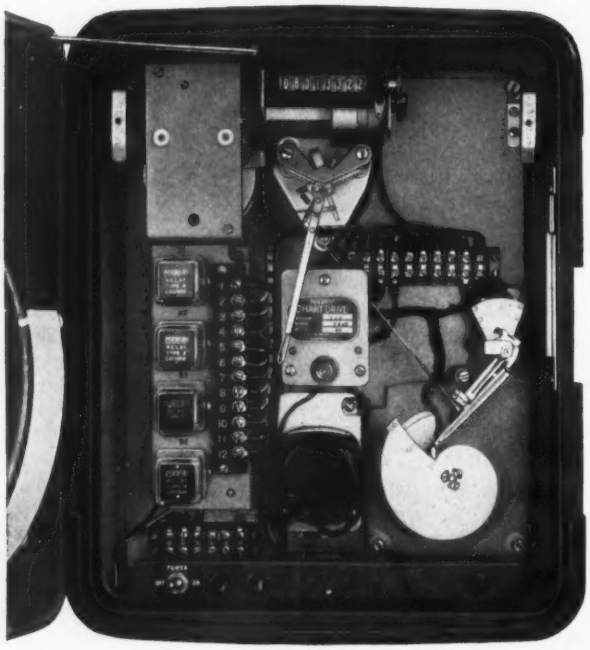

Receiver

## TELETAX by Foxboro

*You can now get* the full benefit of Foxboro accuracy and reliability for *remote* measurements, too! Teletax, the Foxboro impulse-duration system, brings new durability and simplicity to telemetering. For example, in the compact Teletax Receiver, dust-proof, plug-in relays and a husky reversing motor drive the recording pen positively. Maintenance is all but eliminated. And when servicing *is* necessary, *every* component is easily replaceable as a separate unit.

Teletax will transmit any measurement made with standard Foxboro measuring elements. Accuracy is ½% of full scale . . . regardless of normal variations in signal strength. Get full details on Teletax efficiency and economy. Write for Bulletin **17-11B.**

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**RELIABLE:** Thoroughly proved in actual field installations.

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**LOW MAINTENANCE:** A few drops of oil in the receiver motor every three months is all that's required; low 5 ma dc signal avoids failures.

***Single or dual transmitter or receiver; indicating or recording; totalizing available.***

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### AIR CONDITIONING, HEATING, REFRIGERATION, VENTILATING

1 **Packaged air conditioners** are discussed in 20-p illustrated catalog 6125. Describes '57 models. Design features are detailed and illustrated, and such operating components as cooling coils, fan, fan motor, compressor, condenser and controls are discussed. American Blower, Div American Standard, Detroit 32, Mich.

2 **Air diffusion** selection manual contains 66 pages of grilles and registers. Illustrated bulletin 1-57 has 32 photos, 21 drawings and selection tables for 26 standard sizes. Waterloo Register Co, Inc, Box 72, Waterloo, Iowa.

3 **Electric thermostat,** a single-pole single-throw reverse-acting unit for air conditioners, refrigeration and heater applications is described in bulletin RT-802. Includes a cutaway drawing and installation data. Robertshaw-Fulton Controls Co, 110 E Otterman St, Greensburg, Pa.

4 **Refrigeration** and air conditioning catalog R-657, 24-pp, shows or lists over 600 items and contains company's policies and conditions of sale. John Brinda, Madden Brass Products Co, Aurora, Ill.

5 **Oil coolers** for cooling fluids in lubricating, power and processing applications are described in 4-p illustrated bulletin 12-C. Includes data on design and operating features, material specs, sizes and dimensions plus a handy sizing system. Schutte and Koerting Co, Dept Ht-F, Cornwells Heights, Bucks County, Pa.

### BOILERS AND AUXILIARIES

6 **Induced draft fans** for use with boilers ranging from 5 to 214 hp are described in 4-p illustrated bulletin S1-102. Contains performance tables, dimensions, sample specs and construction features for cast-iron direct drive and steel plate V-belt drive induced fans. Also contains fan selection table. Chicago Blower Corp, 9863 Pacific Ave, Franklin Park, Ill.

7 **Hot-water generators** are subject of 4-p illustrated bulletin 1000. Contains operation data and specs. Includes flow rate chart. International Boiler Works Co, 731 Willow St, East Stroudsburg, Pa.

### CONTROLS, ELECTRICAL AND MECHANICAL

8 **Electric thermostat,** which provides temperature protection in commercial laboratory and industrial equipment, is discussed in 4-p bulletin RT-806. Includes cutaway diagrams, wiring details, application and installation information. Robertshaw-Fulton Controls Co, 110 E Otterman St, Greensburg, Pa.

9 **Pneumatic control** instruments are subject of 44-p illustrated bulletin A130. Includes ten pages of general automatic control theory. Also covers selective cascade and ratio control. The Bristol Co, Waterbury 20, Conn. *(Continued on page 200)*

# 3 dependable products for the diesel industry

## DE LAVAL IMO PUMPS

De Laval IMO pumps do a dependable job during long years of service. The reason is IMO design simplicity. De Laval IMO's have only three moving parts—smoothly intermeshing rotors that propel the fluid axially in a steady flow without churning, pocketing or pulsation. There are no reciprocating parts to wear or become noisy. Quiet, compact IMO pumps are excellent for direct-connected, high-speed operation. They can be furnished in capacities to 1,000 gpm and pressures to 1,500 psig.

## DE LAVAL HYDRAULIC FAN DRIVES

De Laval Hydraulic Fan Drives for air cooled heat exchangers and cooling towers offer these important advantages. They *save* power since the fan operates at full speed only a portion of the time. They provide *accurate, automatic* control of engine jacket water temperature, and also assure complete operational flexibility. These units stay on the job for years. As shown, both IMO motor and speed reducer are mounted and factory aligned on a single bedplate.

## DE LAVAL HIGH PRESSURE TURBOCHARGERS

De Laval turbochargers offer pressure ratios of 3:1 as well as higher compressor and turbine efficiencies than those found in conventional turbocharger systems. Output of heavy duty diesel, gas and dual-fuel engines may be doubled by De Laval turbochargers without increasing thermal loading. Exclusive Monorotor design offers a compact lightweight unit of sturdy construction. De Laval turbochargers are self-adjusting to engine loads, can be used on 4- *and* 2-cycle engines.

*You'll find additional data in these De Laval Bulletins. Write for your copies.*

DE LAVAL

*Steam Turbine Company*

TRENTON 2, NEW JERSEY

George Edwards

## suggests you think about personal maintenance

► ONE OF THE NICEST THINGS about having a little piece in POWER each month is the mail that readers are kind enough to send me. Some comes fairly regularly from fellows I've never met but the letters give me the feeling that we're old friends. Other letters, from guys I've known for years, are usually of the newsy type and, as such, sometimes bring tidings of a disturbing nature.

Such a one came recently from Fred Hartley who works with our mutual friend Roy Henderson in a paper mill out in Wisconsin. Roy, who's chief engineer at the plant, was with me in St. Louis and is one of the most capable guys I know.

Fred's letter tells me that Roy must leave the plant for at least a year's treatment because of an advanced case of TB. Roy admits, says Fred, that the doctor told him that if he'd had a chest X-ray taken several years ago, they'd have spotted the condition in time to make treatment a relatively simple matter. Roy would have had to take it a little easy for a while, but he'd have been able to get back on the job faster.

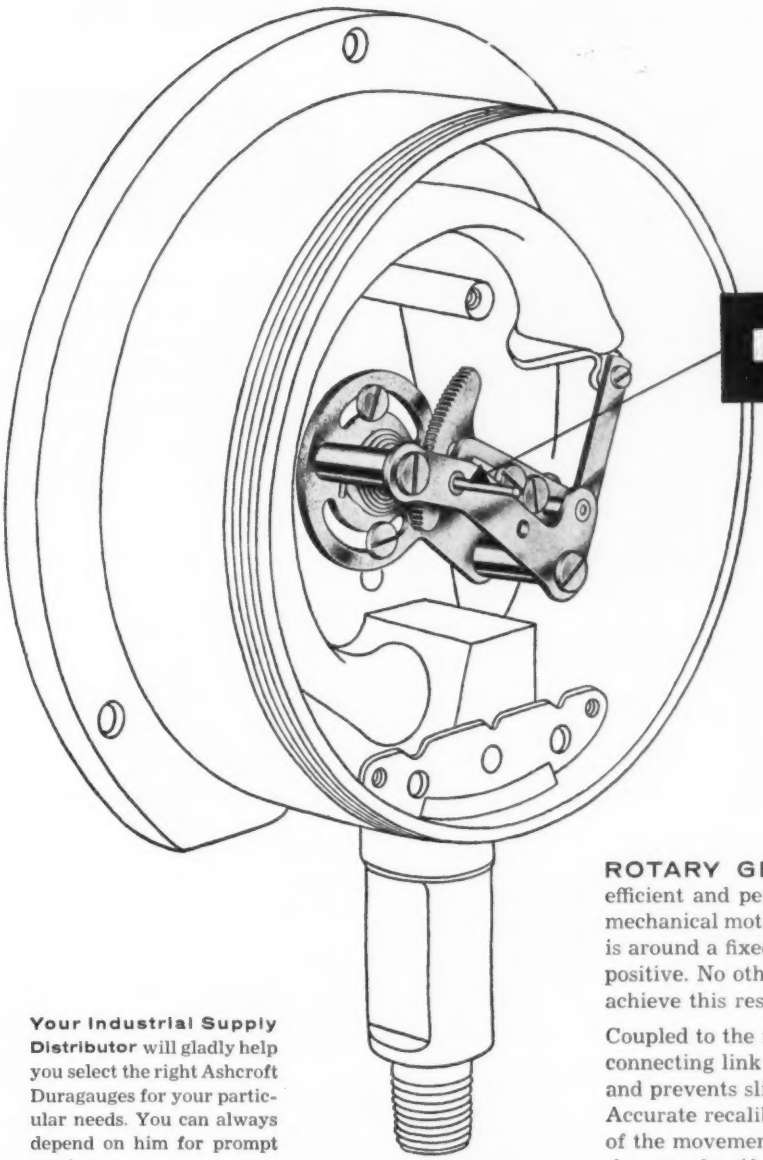
The doctor also told him that his type of work didn't have anything to do with his condition. Some guys just have less resistance than others to certain bugs. It probably would have happened no matter where he worked because he'd never bothered getting a physical checkup.

Here we have a topnotch engineer—a man who kept his operating and maintenance crews in the groove by being a good guy to work for; who kept his plant equipment humming because he was always two jumps ahead of potential trouble spots—having the rug pulled out from under him by a personal "forced outage," an outage that wouldn't have happened if he'd given himself half the care he gave his plant.

Would you call this carelessness? I don't believe so. Roy is anything but the careless type. But I think he was unwise in not remembering that his body has to have its fair share of preventive maintenance.

Curious to see how many guys might be in the same boat, I checked with the National TB Association and was told that chest X-ray programs in industry reveal that one in every thousand examined need immediate medical attention. Some are in the early stages, others more advanced, but there are none who couldn't have gotten the jump on it if they'd had chest pictures taken at least once a year.

It's something for all of us to think about. A scored shaft or burned boiler tubes can give us a rough time around the plant, but that's a picnic compared to what can happen if we don't take ourselves "off the line" occasionally for inspection.



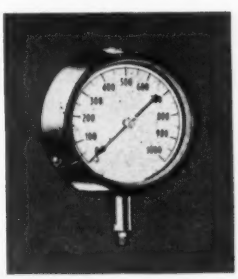
# Why does the MOVEMENT in the ASHCROFT DURAGAUGE outperform all other types?

**ROTARY GEARED MOTION,** the most efficient and perfect method of transmitting mechanical motion ever developed. Because rotation is around a fixed center, pointer position is always positive. No other type of movement can ever achieve this result.

Coupled to the movement is a one-piece connecting link that guarantees correct calibration and prevents slippage or parting under tension. Accurate recalibration is easy from front or rear of the movement. Universal adjustability permits the use of uniformly graduated dials, thereby facilitating maintenance.

The Ashcroft Duragauge is available with all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. There are case designs and materials, Bourdon tube materials, pressure ranges and dial sizes to meet your service conditions exactly. Save time, trouble and money. Specify the pressure gauges of highest sustained accuracy and durability – Ashcroft Duragauges.

**Your Industrial Supply Distributor** will gladly help you select the right Ashcroft Duragauges for your particular needs. You can always depend on him for prompt service.



**In Canada:** *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

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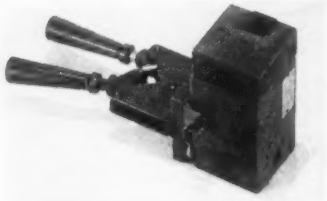

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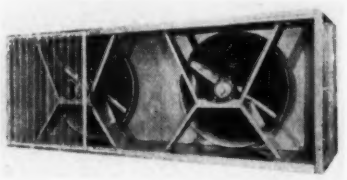
# More EQUIPMENT NEWS

Begins on page 150



## Finned-tube heat exchanger

**810** • Unit is suited for installations requiring the cooling of fluids, or condensing vapors, in chemical process, industrial or power applications. It consists of an arrangement of heavily finned tubes in a casing through which air is drawn by two propeller type fans. Heat transfer is from the fluid through the tube walls and extended surfaces to air that is exhausted into the atmosphere.

According to manufacturer, design provides high heat removal capacity per unit by means that insure movement of air in large volume. There is provision for free drainage of condensate liquids when units are used for condensing.

Units are built in a range of four standard sizes up to maximum dimensions of 63 in. high and 126 in. long. Arrangements provide for stacking vertically or horizontally in multiple unit installations.

**Niagara Blower Co**
**405 Lexington Ave, New York N. Y.**

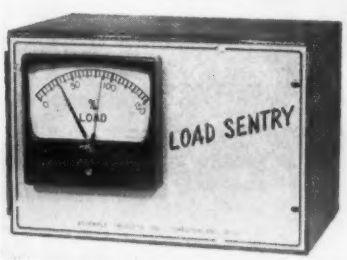
For more details on these items, use post cards p 159. Identify your request with item number.

## Lift check valve

**835** • All-polyvinyl chloride lift check valve is designed for piping engineers. Unit will operate in either a vertical or horizontal position and open and close under less than six lb of pressure. A full 100% flow area is provided.

Valve's only moving part is a self-energizing disc. It is available in ½, ¾, 1, 1¼, 1½, 2 and 3 in. sizes and in either threaded or socket welding types. Material is normal impact polyvinyl chloride.

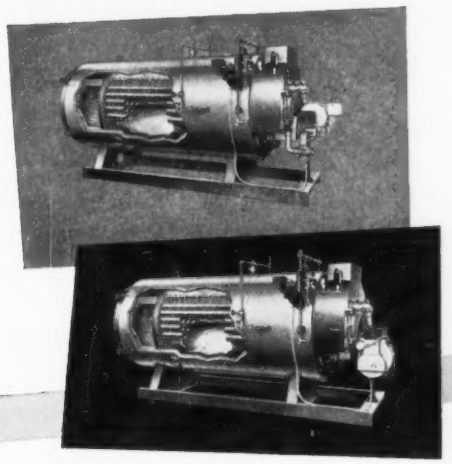
**Tube Turns Plastics, Inc**
**2929 Magazine St, Louisville, Ky.**




## Overload control

**821** • Electro-mechanical control offers continual indication of motor load and adjustable load limits. Unit is intended for use wherever overload of any kind may be

GOOD THINGS
(LIKE HIGH PRESSURE STEAM)
CAN COME IN
# COMPACT PACKAGES



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Are your next specifications for a laundry? A dairy? A cannery, tire recapper, frozen food packer, dry cleaner or other small industrial plant? When processing or power steam requirements figure at 65 hp or less, here is a complete, compact package for the job.

Scottie Junior is a Kewanee boiler and Kewanee burner matched to utilize every available Btu from oil or gas. Six sizes are produced, in both 125 and 150 lb wp. Even the largest Scottie Junior fits under an 8 ft. ceiling, arriving on the job with burner, wiring and all controls in place.

Other Kewanee boilers range to 651 hp and are always ready to prove their world-wide reputation for your clients. Your nearby Kewanee Man has full details, including catalog and specification sheets. Call him anytime. AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 101 Franklin Street, Kewanee, Illinois.

Kewanee Boilers are advertised regularly in national publications.

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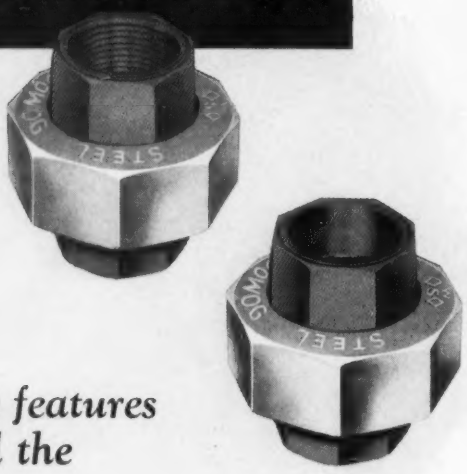
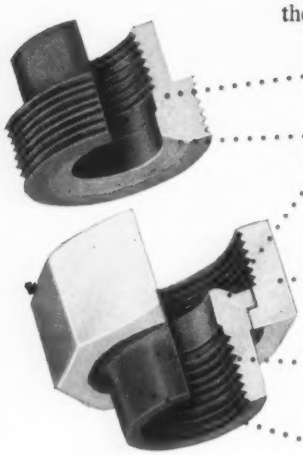
# W-S Forged Steel Unions




*. . . these features tell the difference . . .*

Not all forged steel fittings are alike Careful design and precision manufacture give W-S Forged Steel Unions these important features that tell the difference:



1. Designed to AAR dimensional specifications.
2. Steel-to-steel seats, with spherical-to-angle mating surfaces. Angle is rolled to extra hardness to resist galling.
3. Cadmium plated nuts for resistance to corrosion and to galling and siezing.
4. End pieces protected against rust by new W-S blue synthetic coating.
5. Octagonal end pieces for better gripping.

W-S Unions are machined from forged steel in accordance with ASTM material specifications A-105, Grade 2. They are available with screw-end and socket-welding end pieces in 3000 lb. class, sizes ⅛″ to 3″.

For complete information send for Bulletin U-1. Write to W-S Fittings Division, H. K. Porter Company, Inc., P. O. Box 95, Roselle, N. J.

HKP W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.

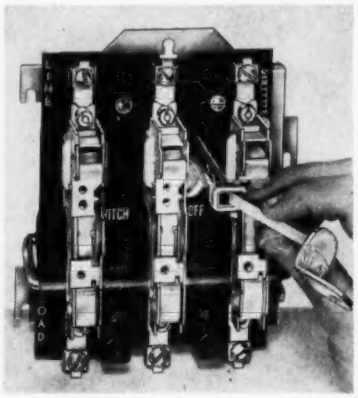

## More EQUIPMENT NEWS

Begins on page 150

registered on an electric motor. It is built around the positive action of a contact meter relay, and has no electron tubes. According to manufacturer, it is easily hooked into "start-stop" switches.

An interlock keeps circuit broken after an overload until condition causing the trouble has been corrected and a manual reset button has been pressed to restart the motor. As a second safety feature, manufacturer points out that any abnormal condition, even failure of parts within the control, will short out the load relay.

**Assembly Products, Inc**
**Chesterland, Ohio**




### Adjustable-shaft disconnects

**820** • Disconnects with adjustable operating shafts have ratings ranging from 30, 60, 100 and 200 amps.

Telescopic operating shafts are said to eliminate the need for supporting structures compensating for differences in depth between enclosure and disconnect in control centers, switchboards, and other electrical control equipment.

Both standard and long length shafts are available. With long length shafts, says manufacturer, it is now possible to mount 200-amp switches in boxes up to 20 in. deep and the smaller switches in boxes up to 14 in. deep.

**General Electric Co, Plainville, Conn.**

For more details on these items, use post cards p 159. Identify your request with item number.

### Expansion joints

**830** • Corrugated self-equalizing joints are designed for use in power and process piping systems.

In protecting piping and related equipment against damage due to temperature change, these joints employ equalizing rings to distribute pipe line expansion equally to all of the corrugations. This, states manufacturer, prevents over-compression of corrugations beyond their design limits.

Equalizing rings also support the roots of the corrugations against internal pressure. This permits use of thinner metal

# IT STICKS TO HOT OR COLD SURFACES!

# EAGLE-PICHER

# SUPER "66"

## INSULATING CEMENT

SPOTTING! TROWELLING! FINISHING!

- Because it sticks, Super "66" saves time—applies quickly to any equipment, cold or hot! Effective up to 1800 F.
- Because it sticks, Super "66" saves money—provides far greater coverage and more efficient insulation.
- Because it sticks, Super "66" makes difficult jobs easy—can be used on irregular shapes where application of other insulations is often impossible. Usually requires no reinforcing on applications up to 1½ inches thick.
- Unique "springy ball" structure of small, resilient mineral wool pellets results in maximum efficiency—maximum fuel savings!
- Super "66" contains a special rust inhibitive which actually prevents corrosion!

*Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.*

**FREE SAMPLE!**

**Write today!**

Eagle-Picher Super "66" Insulating Cement conforms to Commercial Standard CS-117-49.

*Since 1843*

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The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

(*Member of Industrial Mineral Fiber Institute*)

How to look at 500 lbs. of steam *safely*

Safeguard your eyes from scalding steam and flying glass. Watch your water level safely through SONDERGLASS, the safe gauge glass. Virtually two tubes in one . . . the outer hardened to resist cold drafts and erosion . . . the inner to withstand great heat.

Sonderglass has been dipped into 450°F oil and repeatedly plunged into cold water without spalling or cracking.

Today, equip your boilers with the safe glass — Sonderglass — and enjoy the satisfaction of knowing that you have the best.

SONDERGLASS

THE SAFE GAUGE GLASS

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NEW PRESSURIZED SPRAGRIP

First Effective Treatment for V Belts

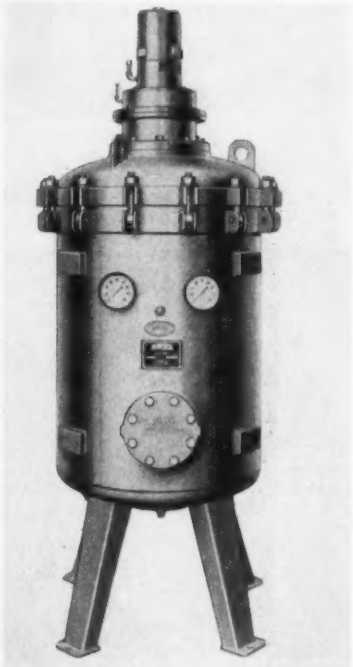
Spragrip is an entirely new development and unlike any other belt dressing you have ever used. It is a permanent type dressing that gives an immediate power boost and will not lose its grip due to aging, oxidizing, glazing or drying out on the belt. Treat your V, flat, round, leather, rubber or fabric belts the easy way. Just press the button on the modern pressurized can of Spragrip and safely spray hard-to-reach sheaves and belts with this power boosting formula. The same formula is packaged in spout applicator cans under the trade name Belt-Flo. Money back guarantee. Write the A. W. Chesterton Co., Everett 49, Mass. for full information.


# More EQUIPMENT NEWS

Begins on page 150

in the bellows, giving the self-equalizing expansion joints lower flexing stresses and thus, longer operating life. Request complete details from the manufacturer.

**Zallea Brothers**
**815 Locust St, Wilmington, Del.**



## Self-cleaning filter

**832** • Dual-purpose fully automatic filter has interchangeable filter elements. Unit can be equipped with filter elements designed for lubricating oils and similar liquids or with elements suited to coolants.

An interval repeat timer provides completely automatic self-cleaning and permits adjusting the length of the cleaning cycle from a minimum 20 seconds to a maximum 30-minute period. Full details on request.

**Bowser, Inc, Lubrication and Filtration Div, 1300 E Creighton Ave Fort Wayne, Ind.**

For more details on these items, use post cards p 159. Identify your request with item number.

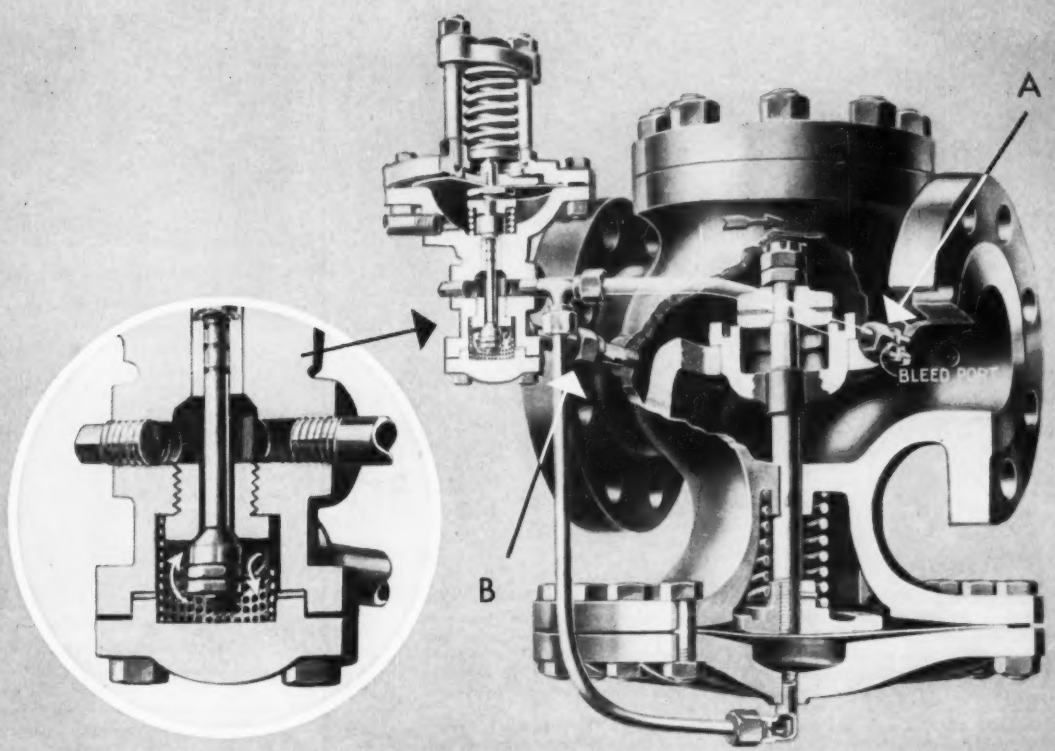
## Corrosion inhibitor

**828** • Water treatment formula is said to control corrosion in cooling tower systems. The new product is effective over a relatively wide range of pH conditions, according to manufacturer, thus making control of pH in cooling water easier.

Material is produced in form of three-in. diameter ball briquettes, weighing approximately one lb each. A simple by-pass feeder is used to apply the chemical.

Manufacturer warns that though this chemical is applicable to a wide variety of cooling waters, it should not be used to

# *Advantages of External Pilots in Automatic Regulating Valves*




Spence Type ED Pressure Regulator

"Maintenance-free, trouble-free, install-and-forget." They're all pretty phrases, but every engineer knows from experience they don't apply to regulating valves. Any valve designed to control temperatures or pressures within tight limits can be affected by dirt or other foreign matter in steam lines.

One advantage of the external pilot mounting shown above is simplified maintenance. Trouble shooting is faster, downtime is reduced, and tempers don't take such a beating. Here's why:

If trouble develops, it's easy to find out if it's in the pilot or the main valve. Just remove the tubing bend at A. A simple test, without any instruments or other equipment, shows where the trouble is.

If the trouble is in the pilot, you can remove it by disconnecting the unions at B. There's no need to take the main valve out of the line.

The quickest way to get the regulator functioning again is to install a spare pilot. This is easy — and in the Spence design it's not expensive to carry spare pilots. Spence pilots fit all sizes of Spence main valves. There's no need to stock an expensive inventory of pilots for each main valve size.

In the enlarged sectional drawing above, you can see how the strainer, seat and disc of the pilot are readily accessible by removing the blind flange.

If the trouble is in the main valve, here again inspection is easy. If there's dirt in the steam line, it may clog the bleed port or restriction orifices. In the Spence design these can be inspected and cleaned by merely removing the tubing connections. The seat and disc of the main valve can also be inspected easily by removing the top flange.

These maintenance advantages, plus other advanced design features, are available for a wide range of regulating applications. For information on Spence's wide range of different automatic regulating valves, write for your copy of Bulletin 1005.

**SPENCE ENGINEERING COMPANY, INC.**
*Walden, New York*

Clean Oil

SAVES YOU MONEY!

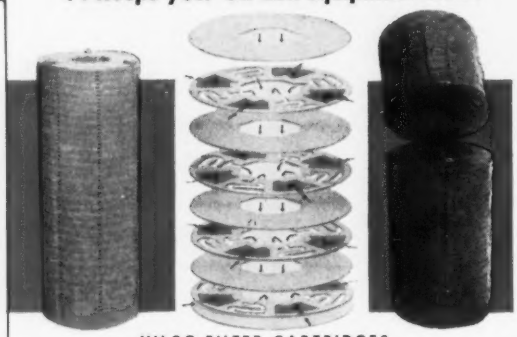
HILCO

OIL MAINTENANCE EQUIPMENT

. . Keeps your Oil and Equipment Clean

FILTER

Furnished in capacities from 0.1 to 750 gpm. Various cartridges available for mineral and inhibited detergent oils.



HILCO FILTER CARTRIDGES

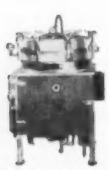
The result of much research in the field of lubricating, fuel and industrial oil filtration, the new patented HILCO Filter Cartridges meet the need for tremendous filtering area, low pressure drop and high dirt storage capacity. Above: Fig. 1 is a new cartridge; Fig. 2 is a used cartridge (note that pockets are completely filled and the outer surface covered with solids); Fig. 3 shows the flow of oil, the dark area represents dirty oil passing into the pockets while filtered oil (white area) passes into "S" shaped section.

**HILCO Purification Means *Complete* Oil Purification . . .**

You get absolute removal of sludge, acids, carbon, water and fuel dilution with a properly selected HILCO. Clean oil saves you money. Expensive maintenance is reduced, equipment shut-downs practically eliminated, lost man hours and cuts in production become a thing of the past. HILCO continuous, all electric, automatic purification keeps your oil clean and in top condition at all times. You receive the full capacity and economy of your equipment.

HILCO offers a wide range of oil purification units to meet every oil conditioning problem. HILCO units are manufactured in both stationary and portable models. Write us about your purification needs . . . recommendations are given with no obligation. Let HILCO put its 25 years of experience in oil purification to work for you.

***THERE'S A HILCO FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM***



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# More EQUIPMENT NEWS

Begins on page 150

treat potable waters or in cases where contamination of potable waters might occur.

**National Aluminate Corp**
**6222 W 66th Place, Chicago 38, Ill.**

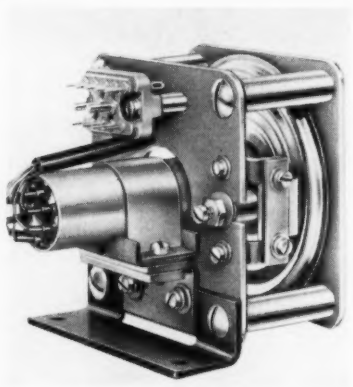
## Adjustable motor base

**841** • Unit virtually eliminates stretched and sagging belts, according to manufacturer. With this base, belt take-up is accomplished by adjusting only one screw. This adjustment is safely made without stopping the motor.

Belts can be replaced by loosening the adjusting screw and swinging it aside, freeing the top plate and motor. These can then be moved far enough to allow replacement of the old belt. Once new belt is back in place, motor is moved back in place, the adjusting screw swung back, tightened and the machine is back in operation. Full data available from maker.

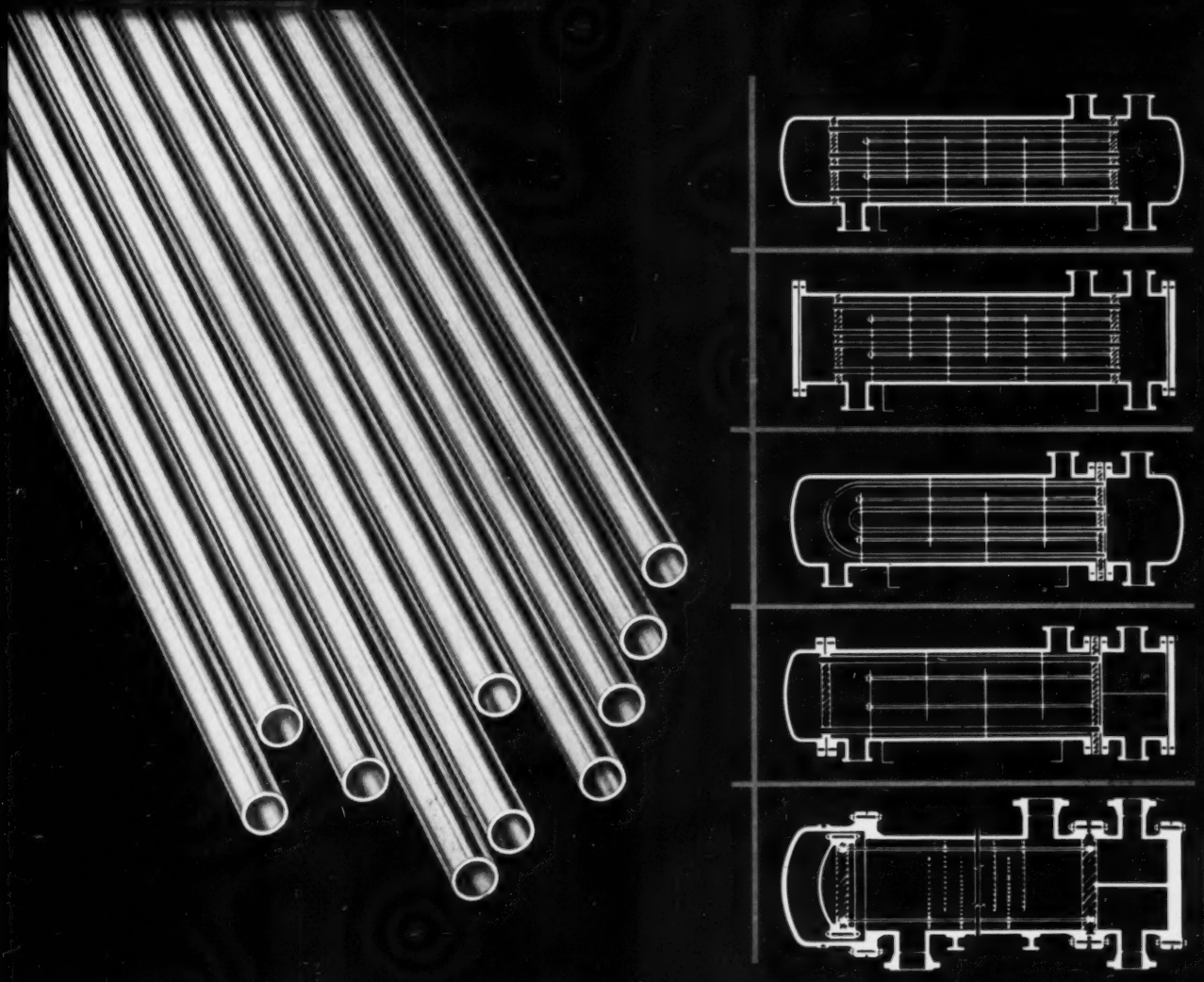
**The American Pulley Co**
**4200 Wissahickon Ave,**
**Philadelphia 29, Pa.**

For more details on these items, use post cards p 159. Identify your request with item number.



## Pressure transducer

**825** • Unit, developed for use in data reduction systems, converts a 3-15 psi signal to ac millivolts directly proportional to the pneumatic input. When pressure is



# Here's How to Check Corrosion, Prevent Product Contamination

When you have problems of corrosion and product contamination in your heat exchangers and condensers, then it's time to specify B&W Tubing. In an extensive range of processes where these points are key factors, the selection of the best tube steel analysis for the best performance is, in every case, your first requirement.

Because B&W Heat Exchanger and Condenser Tubing is made in a wide variety of carbon, alloy, and stainless steel grades, seamless or welded, and in a full range of combinations of diameters and wall thicknesses to meet practically every requirement, you can select the most economical and dependable tubing for your specific application. Designers prefer B&W Tubing and shop men know from on-the-job experience that it's easy to bend, to roll-in, and to weld.

Call on Mr. Tubes at your nearby B&W Tubular Products Division District Sales Office—let him help you solve your heat exchanger or condenser tube problems. Write for bulletin 329. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA-7006-PG3

**Seamless and welded tubular products, seamless welding fittings and forged steel flanges — in carbon, alloy and stainless steels**

# New RIDGID 4PJ Geared Threader is now JAM-PROOF

"...It's Safe, Boss... I Don't Need To Watch It ...It Won't Jam"

Patents Applied for

RIDGID 400A Power Drive with Universal Drive Shaft operates 4PJ Threader on 2½" to 4" pipe held in Tristand Chain Vise, all RIDGID products.

## *Automatically Stops Threading After Standard Length Thread Is Cut

Power drive threading is safe and easy with this new 4PJ—no more watching of either die stock or drive! 4PJ can't jam—drive pinion kicks out automatically after full thread is cut. Extra-easy to handle... mistake-proof workholder, no bushings . . . fully enclosed gears . . . RIDGID most-for-your-money—Buy new 4PJ at your Supply House!

**The Ridge Tool Company, Elyria, Ohio, U.S.A.**

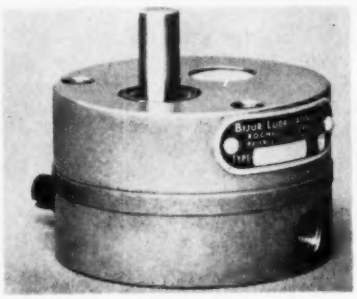
RIDGID
Work-Saver Pipe Tools


# More EQUIPMENT NEWS

Begins on page 150

applied to sensing element of transducer, resulting movement of an expandable capsule displaces an armature which induces opposing voltages in twin secondary coils. This voltage is linearly proportional to pressure input. Output may be used to position an indicator, recorder or control device. According to manufacturer, accuracy of unit is 0.25% of full scale.

**Fischer & Porter Co**
**93 Jacksonville Rd, Hatboro, Pa.**



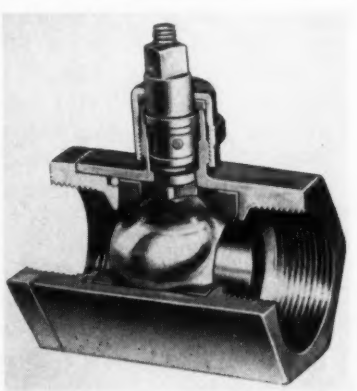
## Gear pump

**823** • Sealed gear pump measures 2½ in. in diameter. Featuring a special seal this uni-directional pump can be mounted on any machine requiring fluid circulation for lubrication or other purposes.

Designed to be driven from a rotating machine shaft either directly or through a gear or chain drive of suitable ratio, pump is applicable to machine tools, or any other machine requiring flood lubrication over gear trains, chains or cams. It is intended for recirculation sump systems.

**Bijur Lubricating Corp**
**Rochelle Park, N. J.**

For more details on these items, use post cards p 159. Identify your request with item number.



## Vacuum ball valves

**836** • Units are available in sizes from ¼ in. to 6 in. in either manually or air-operated models. They can be made of bronze, aluminum, mild steel, 303 or 316 stainless steel or polyvinyl chloride. All valves are tested for vacuum tightness on

# WHEN YOU'RE IN A SQUEEZE FOR A PUMP

SERIES 1522, 1531 AND 1510
CENTRIFUGAL PUMPS
AVAILABLE FROM STOCK
Only sizes listed herein are covered in factory stock at Morton Grove, Ill., for immediate shipment. For other sizes see regular catalog.
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Eliminates customary packing gland leakage! A carbon Seal Ring forms on a "Remite" floating seat—a new material so hard it will scratch glass—never pitted, corrosion resistant, self lubricating. This leak-proof feature means long trouble-free life.
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## FOR FAST ACTION

SEND THE COUPON TODAY FOR THIS CATALOG OF

## B&G STOCK PUMPS

Why take a production loss because of a pump breakdown? B&G *maintains a factory stock of the most commonly used sizes of centrifugal pumps for immediate delivery!* Base-mounted and integral-motor pumps as listed in B&G Stock Pump Catalog are available in capacities to 325 GPM, heads to 140 ft.

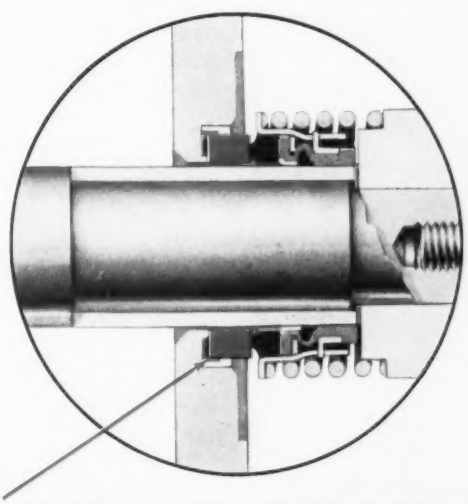
Your local distributor or B&G Representative will be glad to assist in selecting the proper pump for your needs. Or, write, wire or phone the Bell & Gossett factory at Morton Grove, Illinois. In any case, you'll get fast action.

**B&G SERIES 1522, 1531 AND 1510 STOCK PUMPS ARE DISTINGUISHED BY VERTICAL SPLIT-CASE DESIGN...NON-OVERLOADING MOTORS...BRONZE FITTED CONSTRUCTION . . . LEAK-PROOF "REMITE" MECHANICAL SEAL**

Why B&G Centrifugal Pumps give years of trouble-free performance is evident from their design features.

Vertical split-case construction permits removal of the bearing bracket without disconnecting pipe lines or motor leads. Solid cast iron volute—with support feet in larger sizes—prevents transmission of piping strains.

The shafts are made of special alloy steel, super-finished and oversized to keep deflection at a minimum. In Series 1522 and 1510 Pumps oil lubrication affords continuous protection to the heavy duty bearings. Leak-proof operation is assured by the "Remite"* Mechanical Seal—an exclusive B&G development.



***LEAK-PROOF "REMITE"* MECHANICAL SEAL**

This latest advance in B&G pump engineering features a floating seat of "Remite"...a new material developed after years of laboratory experimentation. "Remite" is so hard it will cut glass or steel—eliminates packing rings and gland adjustment. Seal is self-lubricating.

**BELL & GOSSETT COMPANY**
**Dept. EX-36, Morton Grove, Illinois**

*Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive Toronto 16, Ontario*

BELL & GOSSETT CO., Dept. EX-36, Morton Grove, Ill.
Please send a copy of the B&G Stock Pump Catalog CSP-257A.

*Name*.....

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*City*.....*Zone*.....*State*.....

**prevent** CORROSION
**and remove...**

# in your cooling system!

*with*

*Custom-Formulated* **MEMPO** *Products*

It may save you a lot of money to have a DEADY (say Dee-Dee) Corrosion Consultant study your cooling tower problems. There's sure to be a MEMPO product formulation and the right DEADY METHOD to treat your cooling water — to prevent the corrosion, scale, algae, bacteria and odors that inhibit the efficiency and operation of your cooling system.

MEMPO Products are a series of Metal Polyphosphate chemicals (crystals, powders or liquids) that are modified and/or formulated to meet your individual plant conditions. The exclusive DEADY METHOD is the only comprehensive system of control, through the use of these chemicals, to assure proper results.

The DEADY water treatment laboratories (Chemical and Engineering Specialists) — unequalled anywhere — can prescribe the MEMPO treatment for your problems. The treatment will be applied and periodically checked by a DEADY field engineer using the exclusive DEADY METHOD.

DEADY
Say: DEE-DEE

MEMPO Products have also been applied most successfully to evaporative condensers and industrial air conditioning systems. Complete details are available from

**DEADY CHEMICAL COMPANY**
Kansas City 15, Ks.
Los Angeles, Cal.

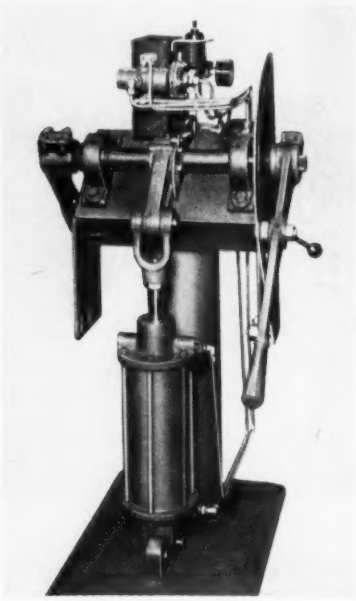

# More EQUIPMENT NEWS

Begins on page 150

a helium sensitive mass spectrometer leak detector.

They will hold vacuum in either direction, are light, compact and allow mounting in any position. A minimum of interior surface avoids outgassing associated with complex designs. Dirt in the system can be tolerated because of the wiping action of the seals on the ball surface.

**NRC Equipment Corp, 160 Charlemont St, Newton Highlands, Mass.**



## Pneumatic drive units

**838** • Unit may be adjusted with linear, square, or square root characteristics, or may be field characterized for special applications. It is designed to position such control devices as butterfly valves, control valves, dampers, louvers, rheostats, vanes and variable speed drives by remote automatic or manual pneumatic signals having a range of 0-20 psig. Details on request.

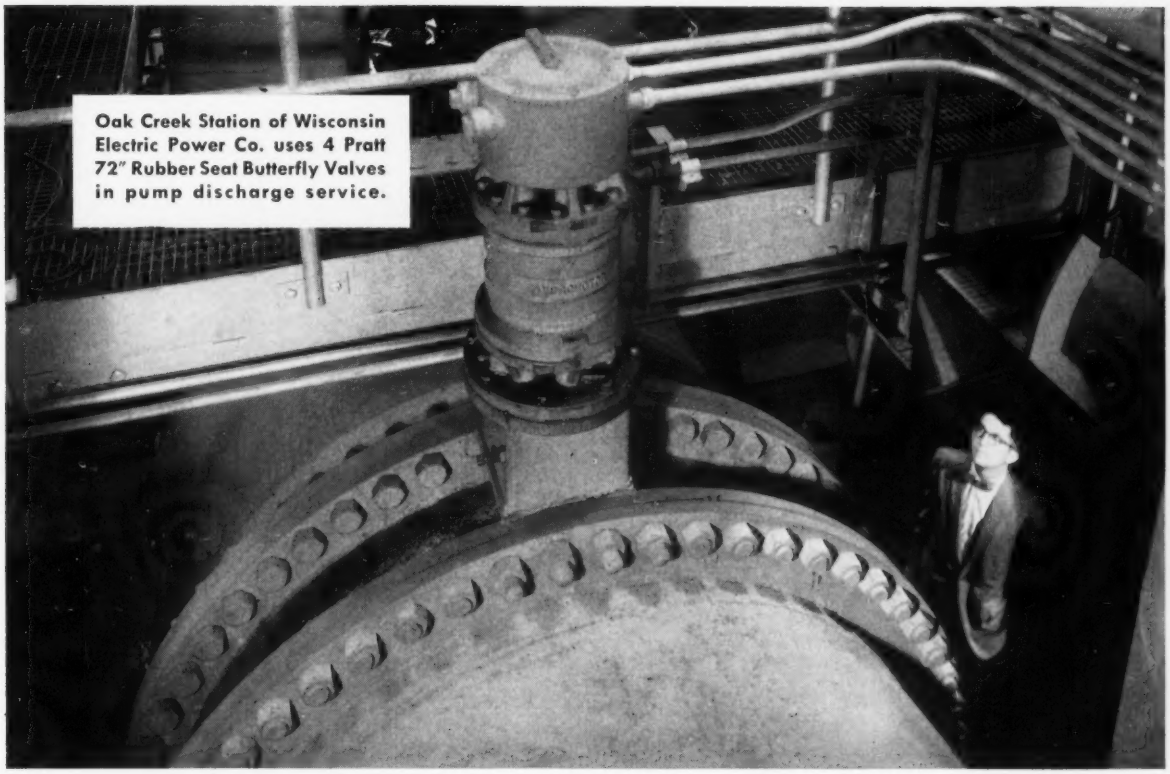
**Copes-Vulcan Div**
**Blaw-Knox Co, Erie, Pa.**

For more details on these items, use post cards p 159. Identify your request with item number.

## Electromechanical computer

**831** • Device translates from dials of two gages the measure of thickness of steel strip and presents the data as a three-digit number representing actual thickness in thousandths of an inch.

Data can be presented instantaneously in printed form or transmitted as an illuminated figure to any number of desired read-out locations in the mill area. Thus, the new signal-converter is said to make for faster and more accurate reading of finished-strip thickness and to help coordinate



Oak Creek Station of Wisconsin Electric Power Co. uses 4 Pratt 72" Rubber Seat Butterfly Valves in pump discharge service.

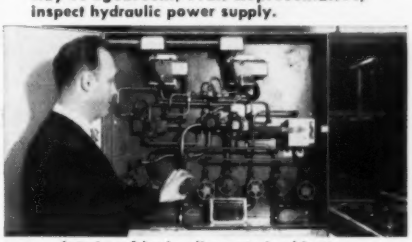
# *MILWAUKEE*...Pratt Butterfly Valves offer "two valves in one" for pump discharge

Pratt Rubber Seat Butterfly Valves in pump discharge service can be made to open and close in synchronization with pump operation, AND they close drop tight—combining, in a single valve, the functions normally achieved by separate shutoff and check valves. The simple combination of disc, shaft and efficient closure provides years of dependable performance without maintenance problems.

Pump discharge valves at Oak Creek Power Plant are hydraulically operated with oil motors. The electro-hydraulic system includes a bank of accumulators and complete auxiliary manual controls to permit operation under any emergency condition.

Pratt pioneered the use of rubber seat butterfly valves in power plants, and today offers the greatest aggregate experience on butterfly valving in the power field. For valve design—**with imagination**—see Henry Pratt.

Felix Kazmerchak, Ass't. Plant Engineer, and Ray F. Egebrecht, Pratt Representative, inspect hydraulic power supply.



Interior of hydraulic control cabinet.

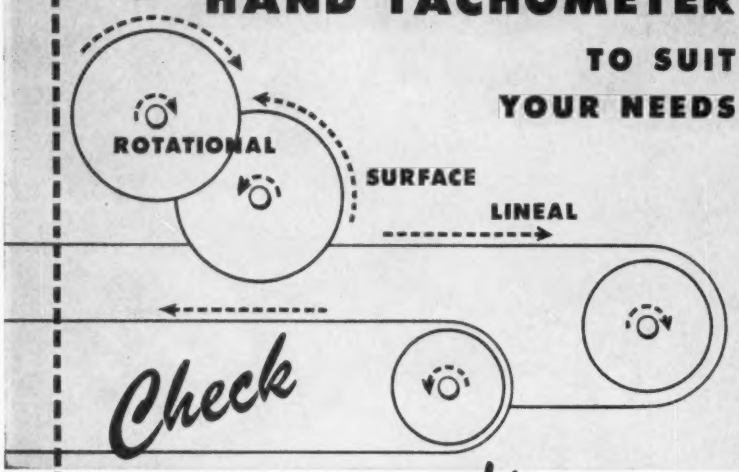
**Have you sent for your copy?**...of Pratt's 40 page **Manual of Rubber Seat Butterfly Valves.** Useful—contains latest pressure drop and flow data, conversion tables, butterfly valve theory and application. CATALOG B-2K

HENRY PRATT

RUBBER SEAT Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

THERE'S A BIDDLE HAND TACHOMETER TO SUIT YOUR NEEDS

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STRESSES
LOAD
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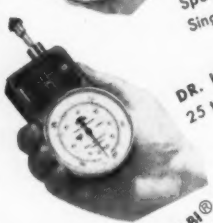
POWER TRANSMISSION
ETC.

Speeds Accurately

JAGABI® TACHOMETER
Speeds Up to 48,000 RPM
Single or Multiple Ranges



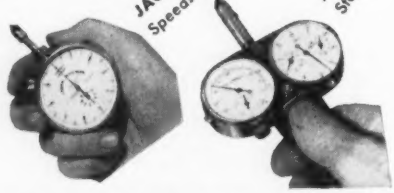
DR. HORN TACHOMETER
25 to 30,000 RPM—6 ranges

JAGABI® SPEED INDICATOR
Speeds Up to 100,000 RPM

JAGABI® TACHOSCOPE
A Speed Counter and Stop Watch in one

FRAHM®

RESONANT REED TACHOMETER. No contact with moving parts—just touch to case of machine or motor housing—read directly in rpm.



Write For "Biddle Speed Instruments"—BULLETIN 35 – P

JAMES G. BIDDLE CO.
Electrical & Scientific Instruments
1316 ARCH STREET, PHILADELPHIA 7, PA.

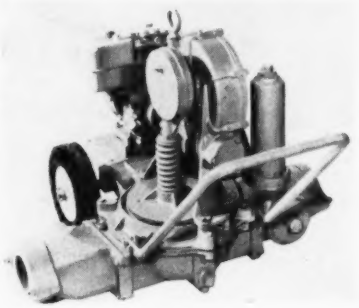
B-701


# More EQUIPMENT NEWS

Begins on page 150

the operation of the various controls on hot strip-rolling mills. Request full details.

**United States Steel**
**Applied Research Laboratory**
**Monroeville, Pa.**

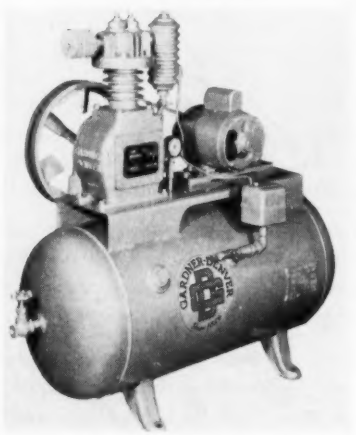


## Diaphragm pumps

**822** • Units feature worm gear drive which reduces speed from engine to pump in one step. This drive is said to eliminate intermediate speed reducers on engines and motors. According to manufacturer, this makes for lighter weight, compactness and more efficient transmission of power.

Unit is available with suction accumulators and swing type valves, as shown, or with ball check valves. Pumps may be obtained with any standard engine or electric motor according to manufacturer, and may be furnished without power if desired.

**Rice Pump and Machine Co**
**Belgium, Wis.**



## Small compressor

**829** • Unit supplies oil-free air for operation of instrument controls as well as for other industrial applications. Single-stage air-cooled unit is available base- or tank-mounted.

According to manufacturer, it supplies 4 to 5 cu ft of oilfree air per min, and is suitable for discharge pressures of 40 to 100 psi. Automatic start and stop controls are supplied as needed. Details on request.

**Gardner-Denver Co**
**Quincy, Ill.**

*View between the two 2250-ton compressors at Garden State Plaza.*

*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

## *Piping that helps*
# AIR CONDITIONING
## *PAY OFF*

● Air conditioning has become a giant industry because it provides valuable *user benefits*...more customers, increased working efficiency, greater profit.

Tube Turns is proud to be associated with this growing business, giving it assistance in piping engineering and supplying the top-quality, welded-piping fittings essential for dependable air conditioning systems.

More than 12,000 TUBE-TURN* products are available from your nearby Tube Turns' Distributor for *all* your needs in welded piping of *all* kinds.

**AIR CONDITIONED.** Buildings alone for the new Garden State Plaza Shopping Center at Paramus, N. J., cover 10 acres. Two 2250-ton compressors provide for the air conditioning system. All welded piping with TUBE-TURN fittings ranges from ½" to 18" diameter. Architect-Engineer: Abbott, Merkt & Co.; General Contractor: Joseph L. Muscarelle; Mechanical Contractor: Frank A. McBride Co.

*The Leading Manufacturer of Welding Fittings and Flanges*

# TUBE TURNS
LOUISVILLE 1, KENTUCKY

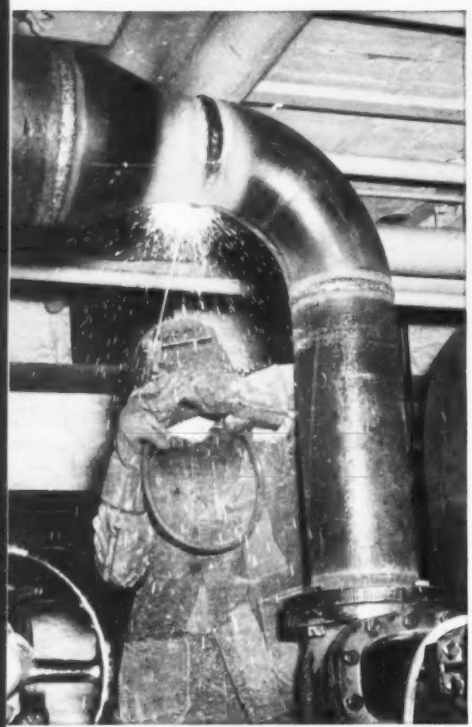
A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit • Atlanta • New Orleans • Houston • Midland
Dallas • Tulsa • Kansas City • Denver • Los Angeles • San Francisco • Seattle
In Canada: Tube Turns of Canada, Ltd., Ridgetown, Ontario • Toronto, Ontario • Edmonton, Alberta

**WHY IT PAYS**

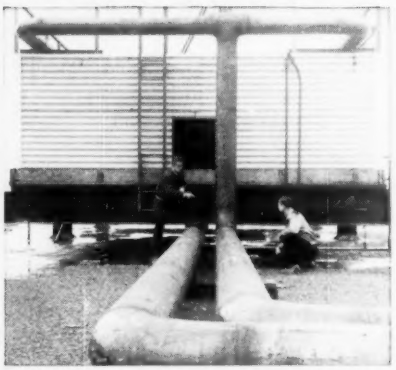
# Why it pays to specify TUBE-TURN® Fittings for

# AIR CONDITIONING PIPING



**FOR SOUND ENGINEERING.** You can specify TUBE-TURN* Fittings and Flanges and *know* you'll get the *right* product, without compromise. For example, you can get TUBE-TURN wrought iron fittings such as used for these condenser water lines in State Capitol Building, Harrisburg, Pa. Contractors: Riggs Distler & Co., Inc.

**ELIMINATES GUESSWORK.** Workers know they are getting the proper fittings as called for on the blueprint because TUBE-TURN fittings are completely and permanently identified as to dimensions, schedule and material.



**FASTER INSTALLATION.** Rigid inspection and quality control insure absolute uniformity of TUBE-TURN products...as to size, circularity and wall thickness. Above: Cooling tower for Bergen-Mall Shopping Center, Paramus, N. J. Photos courtesy Frank A. McBride, Paterson, N. J., mechanical contractors.

**CUT RED TAPE.** Tube Turns' line includes more than 12,000 standard welding fittings and flanges. All are available promptly from your nearby Tube Turns' Distributor. You can fill all your needs with one order to save purchasing manhours. Photo courtesy McJunkin Corporation, Charleston, W. Va.

**HELPFUL DATA**—This new Tube Turns' booklet gives helpful information on pipe, fitting and flange materials. Mail the coupon for your free copy.

**TUBE TURNS, Dept. C-5**
224 East Broadway, Louisville 1, Kentucky

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*Company Address* _____

*City* _____ *Zone* ____ *State* _____

*Your Name* _____

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*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

# TUBE TURNS

**LOUISVILLE 1, KENTUCKY**
A DIVISION OF NATIONAL CYLINDER GAS COMPANY

***This is the latest in precise, adjustable speed control for draft fans and BF pumps!***

E-M standard construction for most indoor applications.

# REDUCE BOILER OPERATION COSTS

## with one of the four *new* E-M ADJUSTABLE SPEED MAGNETIC DRIVES

- **More power in less space**
- **Simpler installation**
- **Better, quieter cooling**
- **Lower maintenance**

E-M Magnetic Drives help you reduce costs of auxiliary drive power and maintenance. Here's how:

**LOWER POWER COSTS** by eliminating need for wasteful throttling of boiler feedwater pumps and draft fans. Magnetic Drives *control speed* for efficient operation of auxiliaries.

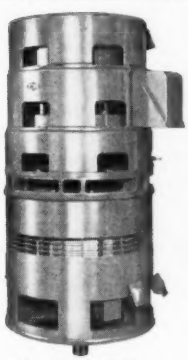
**MINIMIZE FAN EROSION** by operating fans at speeds to fit boiler combustion demands.

**HAVE FAST RESPONSE** to improve combustion and cut down thermal losses.

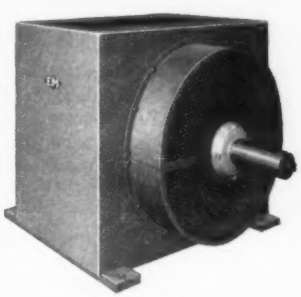
**GIVE ACCURATE SPEED CONTROL.** "Regutron" Control is responsive to *speed* of driven equipment regardless of changes in operating conditions. "Magnetic action" gives $\pm\frac{1}{2}\%$ sensitivity. Anti-hunt and damping circuits assure stable operation.

**OFFER BROAD SPEED RANGE.** A large number of speed steps gives virtually stepless speed control . . . lets you select and keep exact speed.

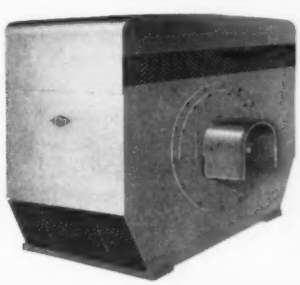
Write E-M for literature, or call your nearby E-M Field Engineer. He'll be glad to tell you first-hand all about the new developments in E-M Magnetic Drives.



Vertical E-M Magnetic Drive and Motor.



Top air discharge type for larger high speed ratings. Heat can be ducted away.



Weather-protected outdoor design. Screened intakes at feet, discharge near top.

E-M

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**ELECTRIC MACHINERY MFG. COMPANY**

Minneapolis 13, Minnesota

*Specialists in making drives do* **EXACTLY WHAT YOU WANT THEM TO**

# RAMBLINGS ON INSTRUMENTATION

## Our "System Safari" Plunges Onward . . . Ever Onward

Last month we plunged recklessly into a conducted safari of boiler plant control systems, going on the rash assumptions that, (1) boiler plant people might achieve better understanding of this subject and (2) having achieved said better understanding, might be apt to buy more Hays instruments or complete systems. If, as a result of our first discussion you did gain a better understanding of control systems but bought *somebody else's* products, please try to pay a little closer attention from here on.

In our last Ramblings we ventured a comparison of the Draft Gauge, (A) to a stethoscope enabling the power plant "doctor" to keep a running diagnosis on his system's respiration.

Continuing the medical analogy, the Flow Meters (B) record the metabolism rate of the system by metering fuel and water flow into the boiler and steam flow from the boiler. A glance at the Flow Meters tells the engineer of any unhealthy conditions, and alerts him to any untoward demands on the system.

The Hays Electronic Mercuryless Flow Meter (paying attention?) is, with due allowance for a certain built-in prejudice on our part, the simplest and most efficient instrument of its kind. It is fully electronic in operation and uses a Hays-designed differential transmission system that makes it independent of line voltage fluctuations and assures maximum sensitivity.

Also, our design eliminates an ancient and expensive bugaboo by using no mercury in the transmitter. With mercury weighing in at about $75 to $100 a refill these days, this represents a considerable savings. Instead Hays uses an overpressure-proof metallic bellows sensing element. The unit is extremely sensitive, with maximum accuracy of ±¼% of full scale differential. And the whole wondrous transmitter mechanism is packaged in a neat unit no bigger than a good unexpurgated edition of the "Arabian Nights".

Up to four different records can be made on the single 12" recorder chart, including air flow, temperature and pressure. Accurate integration through the widest load swings is assured by use of a mechanical type continuous integrator.

In the short time this meter has been on the market we have sold more than 1,800 units . . . without resorting to bubble gum, plastic space platforms or Marilyn Monroe cut-outs. Just clip this ad, send it to me with your name and address and we will send you our recent bulletin on Electronic Flow Meters, in a plain wrapper, of course.

### HLP! HLP!

Hays Corp. nds. service engrs. to instll. & srvce. Hays prods. in cstmrs. plnts. Reqts: a BS deg. in E.E., M.E., or Chem. E. and/or exp. w/Stm. Pwr. Plnt. opration & instrmntn. Petro-chem. exp. also gd. Mich. Cty. is swl. cmnty. in whch. to lv., rs. kds., hv. fn. Exclnt. oppty., wrt. us tdy.!

Phil Sprague Jr.

President

THE HAYS CORPORATION • MICHIGAN CITY, INDIANA


## MARMADUKE

Continued from page 138

no question about Jack being a crackerjack engineer. He really kept the *India Star's* machinery shipshape. But he had one fault. He was so afraid of oil in his boilers that he made life miserable for his shipmates. Reason was he lost a few corrugated furnaces in a Scotch boiler on his first ship years before. I learned that the boiler inspectors had him on the carpet about those combustion chambers and threw a scare into him about losing his license if it happened again. So oil in boilers had become a nightmare to Wyder.

"Ever since, he drove his engineers crazy by running below all hours of the day and night, checking condensate from fuel-oil heating coils or checking the sponges in the inspection tank and hotwell. He'd crawl through the boilers himself when they were opened and wipe the shell with a white rag looking for traces of oil.

"The *India Star* was to make a coastwise trip to load for the Orient, but we were already loaded and were to shove off in a few days for Hong Kong. That night Jack and I went ashore to Fisherman's Wharf for a lobster dinner. After taking in the town we got back to our ships in time for breakfast.

"While ballasting my tanks with the sixth cup of coffee, the third assistant from the *India* came hurrying into our messroom. 'Sorry to bother you Mr Surfaceblow,' he began, standing at the door. 'You better hurry below to our fireroom before Mr Wyder has heart failure.'

"'Why, what's wrong with him?' I asked, stowing away my sixth soft-boiled egg.

"'You know what a bug he is on fuel oil,' he answered excitedly. 'Well, the donkey boiler is loaded with fuel oil. And the chief's going crazy running around checking everything. Keeps raving about losing his license. If someone doesn't stop him he'll drop dead any minute.'

"'I'll be right over,' I said calmly, finishing my chow. A few minutes later I was down in the *India's* fire room. Talk about excitement. Wyder was running around like crazy all right. His second assistant was hot footing after him. But Wyder was too excited to find the source of that oil.

"I examined the gage glasses. They were black as midnight—sure looked bad. Just then Wyder came scooting into the fire room from the engine room. Beads of sweat were rolling down his face. His eyes had a wild look and he was jabbering to himself.

"'Calm yourself Jack,' I said, trying to slow him down. 'I'll give you a hand

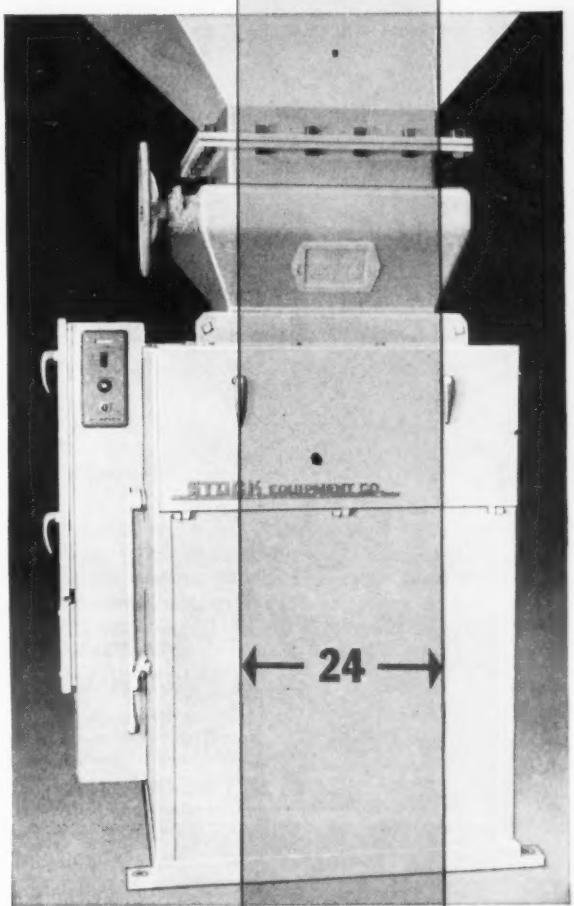
# NEW S·E·CO. COAL SCALE DESIGNED SPECIFICALLY FOR LARGE CENTRAL STATIONS

## Model 50 carries 24" wide stream of coal straight through without baffles, sloping skirts, or other restrictions

Modern push-button power plants burning large quantities of coal find it more desirable than ever to obtain accurate, up-to-the-minute coal weights. These weights help operators get the last BTU from each pound of coal by helping them determine boiler efficiency, keep inventory records and balance mills.

To provide these weights continually and without undue maintenance requirements, Stock Equipment Company engineers have developed the Model 50 Coal Scale. The inlet of this scale is a full 24" inside square. The extra wide feeder belt carries a stream 24" wide. The stainless steel weigh hopper has a 24" wide outlet. Because there are no restrictions or baffles inside the scale body, coal passes through easily, dependably, giving you the maximum in accuracy and trouble-free performance.

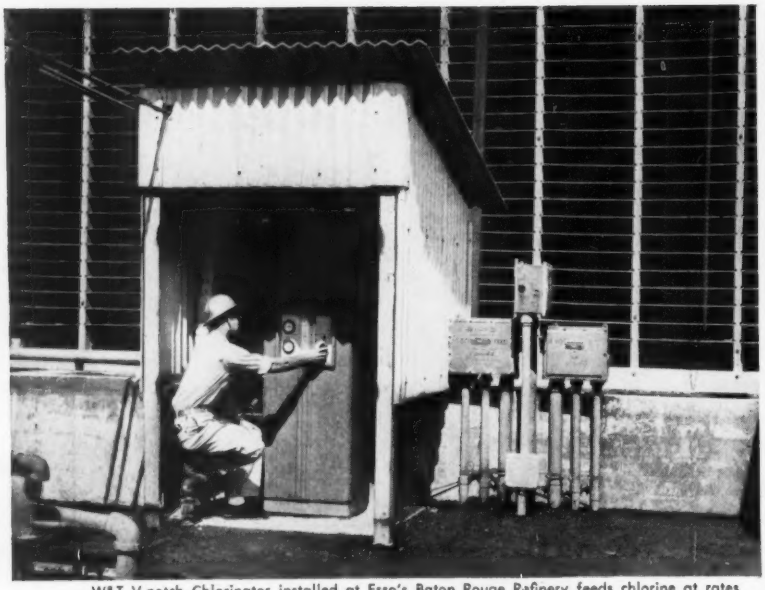
The Model 50 Coal Scale is only one of the ways in which Stock Equipment Company continues to meet the growing and changing needs of modern power plants. Years of experience in bunker to pulverizer and stoker equipment, combined with a constant attention to detail, make any S-E-Co. equipment the best you can buy for the job.




SPECIALISTS IN
BUNKER TO PULVERIZER AND
BUNKER TO STOKER EQUIPMENT

**STOCK Equipment Company**

745-P HANNA BLDG., CLEVELAND 15, OHIO



W&T V-notch Chlorinator installed at Esso's Baton Rouge Refinery feeds chlorine at rates up to 500 lbs./24 hr. Units are available with chlorine capacities up to 2000 lbs./24 hr.

**NEW W&T V-NOTCH CHLORINATORS,**

*used at Oil Refineries, are rugged, easy to operate and moderately priced.*

Esso Standard Oil Co. has a W&T V-notch Chlorinator installed at their Baton Rouge, La., Refinery. The chlorinator, installed in a small shed open to the sun and weather, chlorinates cooling water for slime control.

This type of installation would be considered rugged service for other equipment but V-notch Chlorinators are designed for such use. They are made of materials that are completely resistant to corrosion as well as weather. They are simple to operate and to maintain. In addition, W&T V-notch Chlorinators are an attractive piece of equipment, colored green to fit into industrial color schemes.

For more information about W&T V-notch Chlorinators, send for bulletin CD-44.

**WALLACE & TIERNAN INCORPORATED**

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

**E. R. P. CATHODIC PROTECTION**
**...INDIVIDUALLY DESIGNED FOR EACH APPLICATION**

to prevent corrosion of buried or submerged metal structures

*Write for Bulletin E-37*

E-37

**ELECTRO RUST-PROOFING CORPORATION**

30 MAIN STREET, BELLEVILLE 9, N. J.

## MARMADUKE

*Continued from page 180*

if you'll just stand still and relax.'

"'Calm myself?' he bellowed, ready to strip his gears. 'Look at that gage glass . . . every tube in that boiler'll have to come out . . . but where in hell is that oil coming from . . . that's what I can't dope out,' he stuttered.

"Just then Robinson the port engineer barged into the fire room. He looked at the glass and asked, 'How did that happen, Mr Wyder?'

"'How should I . . . know?' stuttered Wyder, looking like he was ready to cry as he mopped his brow. 'I checked the inspection tank, the hotwell and everything else. There's no trace of oil on the loofa sponges or on the feed-pump strainers. Only place fuel can come from is from a busted oil-tank heating coil. But the hotwell would show that. And you can tell from the gage glass that it ain't cylinder oil—too black for that,' he finished, plopping down on the transfer pump.

"'Well now, wait a minute,' I said, 'I once saw a boiler contaminated by the fuel-oil transfer pump. The new piston rods of the duplex pump that had just been installed had a thin crescent shaped hole through their centers. So fuel oil was pushed through that hole into the steam end.'

"Wyder's face grew a sickly white. I thought he was going to faint. 'But hold it, Jack,' I said. 'Don't worry, that happens only once in a million years. Just remove the valve chest of your pump. That'll tell us in a hurry.' The second assistant was already removing the valve chest cover. We stood around and watched, but there was no trace of oil.

"I checked the hotwell myself, I then looked at the fuel-oil lines in the fire room but could see no unusual hookup. So I went up on deck to clear my head and think. Leaning against the rail near No. 4 hatch I lit a cigar. Soon I found myself looking up at the *India's* stack. One seaman was dangling against it in a bosun's chair about half way up, slobbering it with buff paint. As I watched, two longshoremen passed along the deck. One remarked to the other, 'Yea, but don't forget Fred, all ain't gold that glitters, don't forget that.'

"'Ain't gold that glitters, ain't gold . . . that's right,' I echoed, 'all ain't oil that's black, either.' I took another good squint at the stack. She had a brand new band of black paint around her top, about four-feet wide. The rest was being painted buff.

"With my eyes glued on that stack. I could see the top of the four-inch safety valve escape pipe that ran up

# ANKOR PIPE IDENTIFICATION BANDS

**An economical method for instant identification of pipe lines . . .**

***JUST OPEN . . .***

**The permanently shaped vinylite label is easily placed in position—no tools required.**

***AND SNAP ON!***

**When you let go, pipe label snaps itself instantly into place.**

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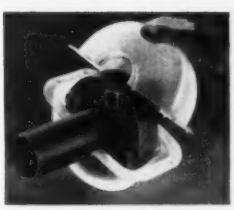
**ANKOR SAFETY FLANGE SHIELDS**

A Safety Factor in processing corrosive and dangerous liquids, designed to completely cover the pipe flange—unbreakable—can be used many times. No tools needed to install.



**ANKOR SAFETY VALVE BONNET SHIELDS**

Cover both packing gland and bonnet flange. Made in two halves and fastened together with snap buttons, the Bonnet Shield can be installed in one minute; removed in one second, without removing hand wheel or other valve parts. Semi-transparant, so that trouble spots can be located without removing the shield.

Find It Fast in The "Yellow Pages"

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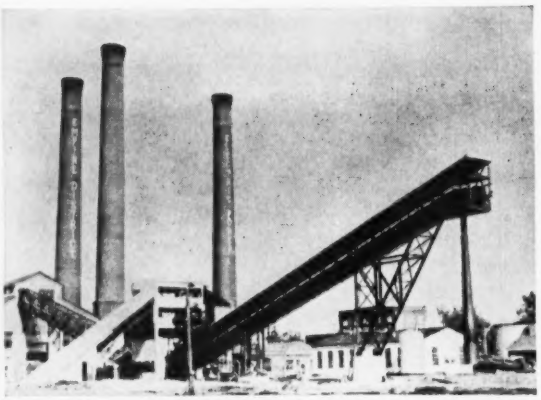
**EARN EXTRA PROFITS IN SAVINGS**



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.

McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

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**COAL-HANDLING SYSTEMS**

***Engineered for Your Plant***

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

**McNALLY PITTSBURG**

*"The Men Who Know Coal From The Ground-Up"*

McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ Title_____

Company_____

City and State_____


## MARMADUKE

*Continued from page 182*

to the bottom of that black band. For some reason I saw some connection between the two, but I don't know why. The more I looked at that black band, the more I thought of those black boiler-gage glasses.

"Just then the port engineer came on deck and walked over to me. 'How in hell you figure that out, Surface-blow,' he asked, lighting up a cigarette. 'Where could that oil come from?'

"'From there,' I answered, pointing to the stack. 'Suppose that seaman dumped what black paint he had left last night when he knocked off into that safety valve escape pipe.'

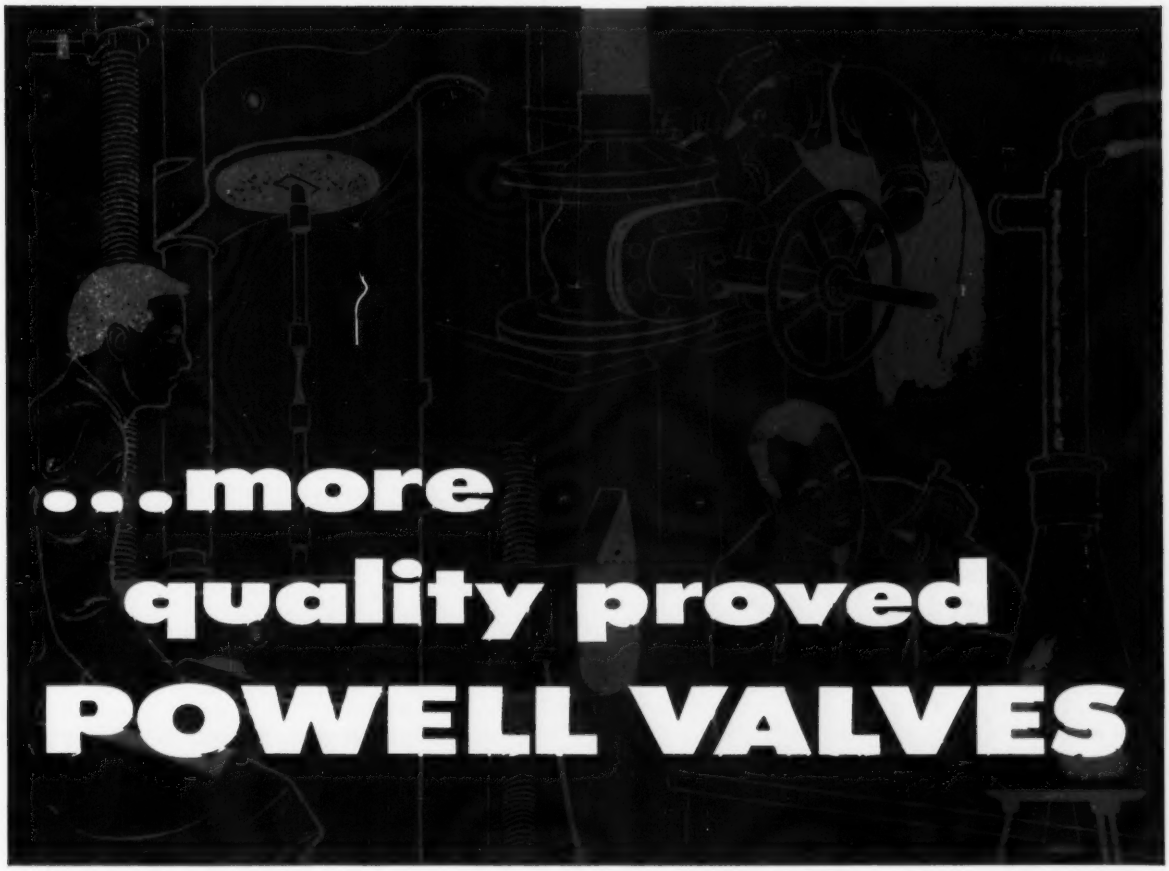
"'You're crazy,' yelled Robinson, giving me a fishy look. 'Or maybe you're trying to kid me. Even if he did, how would it get into the boiler?'

"'Here's my theory,' I said. 'He dumps a can of paint down the pipe at quitting time so he doesn't have to carry it back to the paint locker. I know young seamen. They do some mighty silly things. I understand the center boiler was cut out after working cargo at noon yesterday. So about six this morning the steam gets down to zero on that boiler. Maybe the watertender forgot to open the air cock and a slight vacuum was formed. If her safety valve wasn't tight that vacuum drew in some paint. And being the center boiler, most of that paint ran down on top of the center safety valve disk. Or maybe the watertender popped her safeties when bringing up steam and some paint got in that way. It's crazy, but what's your theory?'

"'That's the cockeyed'st thing I ever heard in over 30 years of engineering,' said Robinson. 'But what makes you think it's paint in the first place?' he asked after a minute, looking at me as if I were drunk.

"'Because I checked everything else,' I answered. 'You can't get fuel oil into the waterside of a boiler without knowing where it comes from. Besides, I took a good look at those glasses. It doesn't have that smeary brown color that bunker C gives a glass. That's what made me suspicious. Then, standing here, I see that black paint at the top of that escape pipe. And I remembered how seamen often throw things over the side at knocking off time just to save time in getting ashore. So all you have to do is add two and two.'

"Wyder came out on deck about then to steady his nerves. He looked mighty sick, like a man who had seen a ghost or something. When the port engineer explained my theory, Wyder just stood there with his mouth open, staring at



# ...more quality proved POWELL VALVES

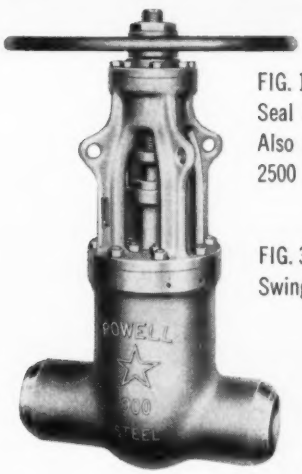



FIG. 19003 W.E.—Steel Pressure Seal Gate Valve for 900 Pounds. Also available for 600, 1500 and 2500 Pounds.

FIG. 3061 W.E.—300-Pound Steel Swing Check Valve.

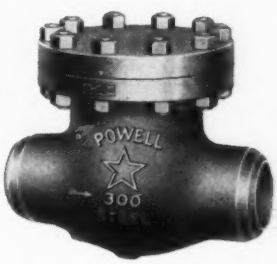
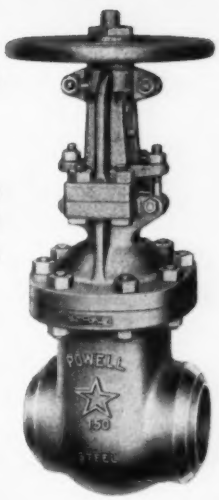


FIG. 1503 W.E.—150-Pound Steel O.S. & Y. Gate Valve.

FIG. 11365 W.E.—Steel Pressure Seal Horizontal Lift Valve for 1500 Pounds. 900-Pound Valves also available.

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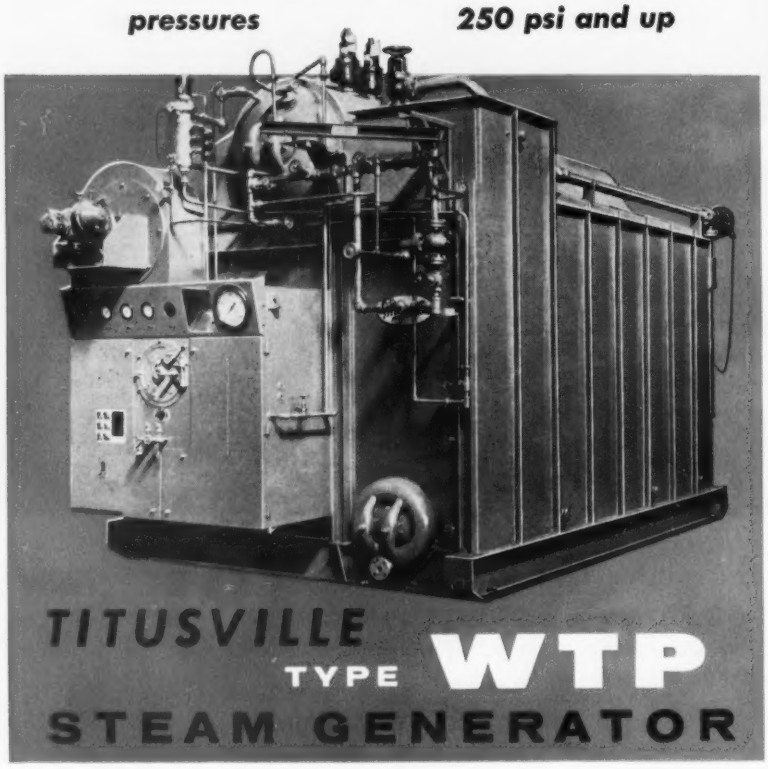

TITUSVILLE TYPE WTP STEAM GENERATOR

Tops in steam generating performance is matched by outstanding dependability in Titusville's Type WTP Water Tube Steam Generators. Completely factory-assembled, ready to ship by flatcar or truck trailer, Type WTP is easy to install in your boiler-room. • Let us show you why and where Type WTP is serving many of the toughest boiler assignments in the country. When writing, ask for Bulletin 5511.

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*Manufacturers of* A Complete Line of Boilers for Every Heating and Power Requirement

**Plants at Titusville, Pa. and Warren, Pa.**

*Offices in Principal Cities*


## MARMADUKE

*Continued from page 184*

the stack and wiping his sweaty face.

"Suddenly he snapped out of it and asked, 'But how you know it's paint?'

"'Because everything that's black isn't oil,' I answered, and went back aboard my ship for another cup of coffee.

"That afternoon one of the mates told me that the seaman admitted dumping his left-over paint down the escape pipe. How did it get into the boiler? I gave you my theory—what's yours? Just goes to show that in power operation truth can be stranger than fiction."—STEVE ELONKA

### Marmy's Mailbox

PLENTY OF FRIENDS

Not only here at Otter Tail Power Company, but my wife enjoys reading the Marmaduke stories. You see we lived in San Francisco when I went to sea, (27 trips around the world) so our home was a sort of jumping off and landing place for shipmates. She knows a lot of places from hearsay. Marmy keeps her posted.

S KRONE, *Canby, Minnesota*

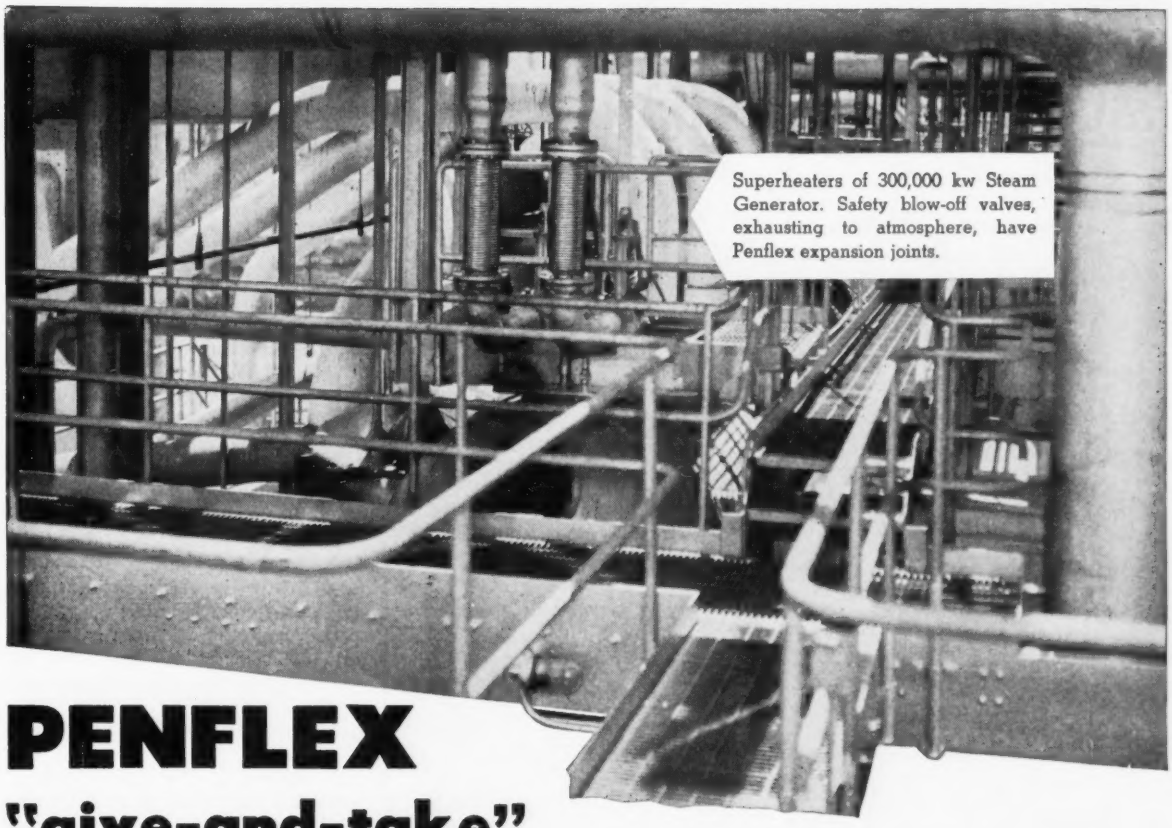
## BUSWAYS

*Continued from page 81*

were used and placed on the load side of 10,000-kva transformer, it could be adjusted to nullify the voltage drop in all transformers if all are fully loaded. But with such an arrangement, any decrease in current in one or more of the branch transformers would cause a voltage drop in all other branches where current had not changed. This is so because a reduction in current passing through the capacitor reduces voltage rise.

If all load is connected at feeder end, a capacitor can be selected so end voltage remains unchanged from no load to full load. Since voltage level varies along the length of a run, it is not practical to select series capacitors for plug-in busway where loads are distributed. That is, select capacitors that will completely nullify voltage drop at all points along the busway. One could be used to hold the voltage level constant at about the one-third point in the run. But there will be a voltage rise at the input end and a drop at the output end equal to about half the normal drop.

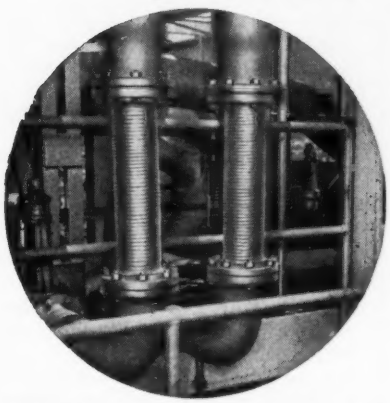
With all studies completed, the Chrysler system was designed to yield satisfactory voltage regulation without capacitors, at least for the time being.



Superheaters of 300,000 kw Steam Generator. Safety blow-off valves, exhausting to atmosphere, have Penflex expansion joints.

# PENFLEX

## "give-and-take" prevents blow-outs on blow-offs



Penflex Galvanized Steel Interlocked Tubing (8" I.D.), flanged at both ends. Installed as expansion joints on safety blow-off valves, they take up to 850 psi steam pressure at 900°F.

Power plant applications like this one can't use less than Penflex Metal Tubing offers in flexibility, strength, and tightness. When safety valves go, expansion joints must hold. Penflex joints *do*. That's because they can give with the pressure and take it, too.

Thermal expansion at 900°F. . . . pressures up to 850 psi . . . impact and pipe movement under these strains—all are safely handled by Penflex. Forty-two complete units in this big power plant are protected from blow-outs by Penflex.

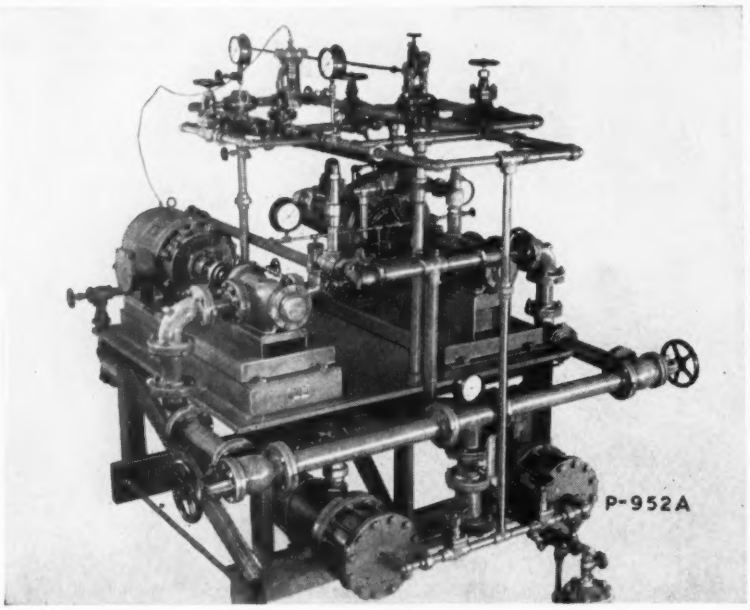
There are hundreds of other applications in the steam and diesel power fields for Penflex Interlocked Tubing and Penflexweld High-pressure Tubing. Call in the Penflex engineer to help you on your own particular problems. In the meantime, write for "Flexineering," your guide in buying and using Penflex Flexible Metal Tubing. There is no charge or obligation.

**Pennsylvania Flexible Metallic Tubing Company, Inc., 7237 Powers Lane, Phila. 42, Pa.**
***Branch Sales Offices:*** **Boston • New York • Chicago • Houston • Cleveland • Los Angeles and Distributors in Principal Cities**

**COMBINES FLEXIBILITY WITH DURABILITY**

COMPLETE RANGE OF SIZES AND MODELS IN BOTH MEDIUM AND HIGH PRESSURE TYPES

MORE COMPACT THAN EVER..




P-952A Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

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NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40 — very interesting and informative.

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Southwestern Division: 2512 South Boulevard, Houston 6, Texas

## PUUNENE MILL

Continued from page 97

cycles. It has totally-enclosed air-cooling system, air coolers designed for 80 F water and a direct-connected main exciter.

The condenser contains 7000 sq ft of 7/8-in. 18-gage admiralty metal tubes, 18 ft long. It is two-pass design on the waterside, with nondivided cast-iron water boxes. For starting, a single-stage hogging ejector evacuates the condenser. A two-stage steam-jet air ejector maintains vacuum.

Each of the steam generators operates at 900 psi, 760 F, and can produce 125,000 lb steam per hr when burning bagasse, 165,000 lb per hr when burning oil. Furnace is water-cooled on four sides and top to reduce refractory maintenance. Unit is complete with superheater, waterwalls, tubular air heater and dust collector. It operates at 67.7% design efficiency when burning bagasse and generating 125,000 lb per hr, and at 85.5% when burning oil at 165,000 lb per hr. Total boiler and waterwall surface is 17,990 sq ft; air heater—18,700 sq ft; furnace volume —7180 cu ft. Drawing, p 94, shows cross section of the unit.

Each unit has a traveling grate spreader stoker for burning bagasse. The pneumatic distributors use high-pressure air to distribute fuel uniformly over the grate. Bagasse feeders are a multiple-chain type with a conditioning roll at discharge end. This prepares the bagasse for uniform feed to assure free passage through chutes, connecting feeders and distributors. Feed rate is automatically controlled. Drawing, p 96, shows bagasse hopper, feeder, distributors and connecting chutes.

**Ash handling.** Bagasse, a very light and pulpy fuel, burns largely in suspension and the resulting ash is carried along with the gas. The heavier carry-over particles fall into a hopper behind the lower drum and the remainder pass on to be trapped by the flyash collector. Ash is removed from these collection points by rotary-seal valves and dropped into a sluiceway that flows to a slurry tank. From there it is pumped to point of disposal.

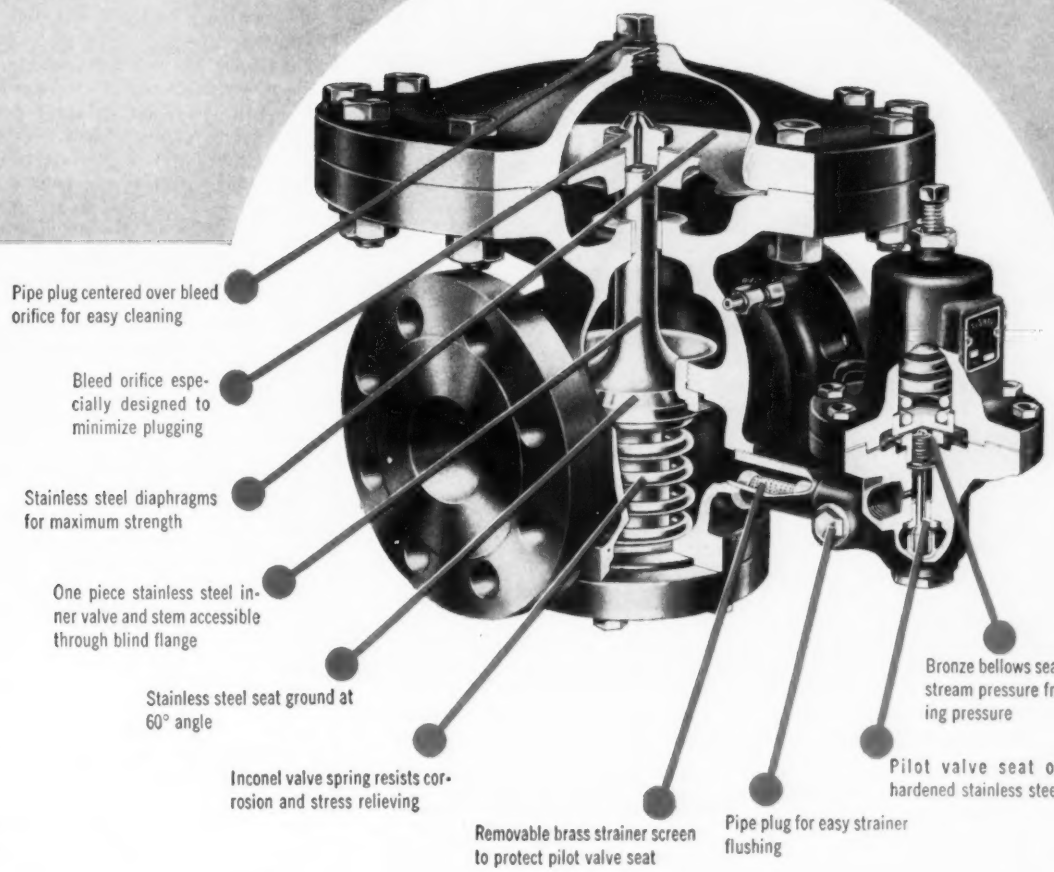
No attempt is made to recover unburnt carbon since the particles are very light and not trapped in quantity except by the flyash collector. Reinjecting from this source would only cause ash recirculation and increase the quantity going up the stack.

The larger pieces of bagasse fall to the grate and burn. This ash is granular, with a small portion fused to porous and friable lumps. The traveling grate deposits it into a hopper where it is removed once a day. Fine ash

# THE FISHER® 92B

# IMPROVED

## TO MINIMIZE PROBLEMS INHERENT IN STEAM SERVICE


Pipe plug centered over bleed orifice for easy cleaning
Bleed orifice especially designed to minimize plugging
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Inconel valve spring resists corrosion and stress relieving
Removable brass strainer screen to protect pilot valve seat
Pipe plug for easy strainer flushing
Pilot valve seat of hardened stainless steel
Bronze bellows seals downstream pressure from loading pressure

Not content with the enviable performance record of the Type 92A, Fisher engineers have improved this pilot operated pressure reducing valve to a new peak of performance.

For extremely accurate, long trouble-free service, put a Fisher 92B in the line. One pilot with three interchangeable springs provides a range of from 2 to 150 psi. • ***Send for Bulletin D-92 today.***

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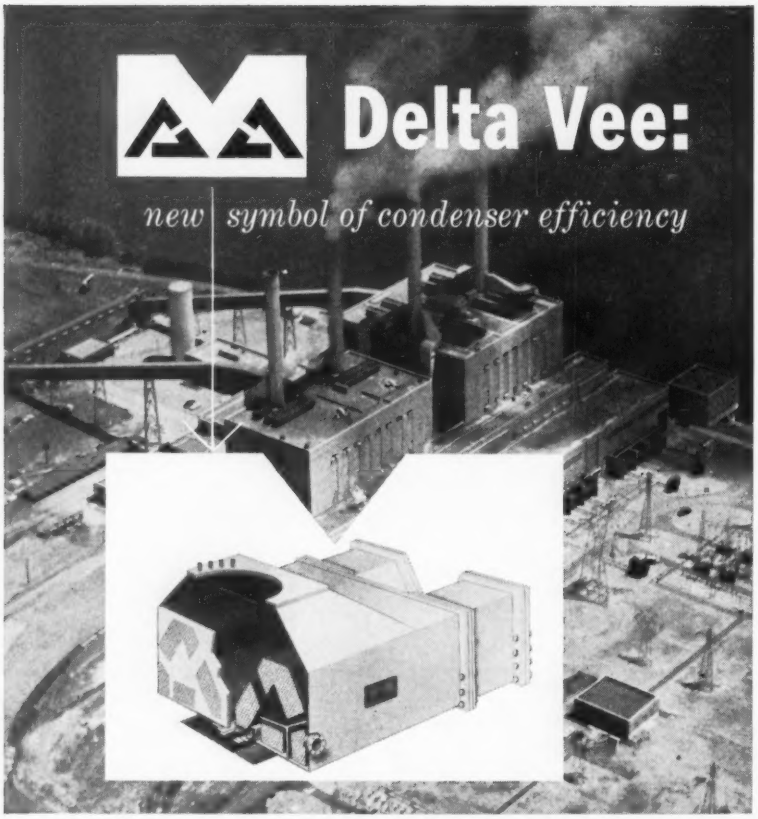



**ONLY SWECO SURFACE CONDENSERS OFFER DELTA VEE DESIGN**

The water circuit uses V-type water boxes and reversing chamber. Roughly 60% of the water feeds the main banks of tubes; the remainder feeds the secondary condensing sections and air-cooling sections at the sides of the water box.

The condensing circuit is in two delta-shaped tube bundles, one group in each half of the condenser. The two groups are mirror images. The main condensing banks are formed by the arms of the deltas; the base forms the secondary condensing sections and the air-cooling sections.

SWECO Surface Condensers are designed for prime mover service with large steam turbines. Available in sizes from 3,500 square feet and up, SWECO Surface Condensers offer these design advantages:

**maximum de-aeration**—from large contact-tube areas, positive steam-vented hot well.

**even distribution of steam**—generous admission area to tube bank reduces water and vapor pressure drop.

**increased efficiency of heat transfer**—condensate forming on upper tubes flows over minimum number of lower tubes, eliminating water blanketing.

**compact installation**—low headroom minimizes excavation or structure necessary to set condenser below turbine.

**accessible for servicing**—end covers are removable, divided water box permits one side of condenser to operate while the other is being cleaned or serviced. (Similar construction is available in non-divided water box design.)

SWECO enters the surface condenser and ejector field with more than forty years experience in the production of pressure vessels and heat exchangers... in thermal and mechanical design... and with complete manufacturing facilities.

Construction, operation and features of SWECO Surface Condensers are described and illustrated in brochure M-3-393. Write for your copy today.

SWECO

**Southwestern Engineering Company**
4800 Santa Fe Avenue, Los Angeles 58, California
*Engineers and Constructors... Manufacturers*


# PUUNENE MILL

*Continued from page 188*

passes through a grid screen, into a hopper feeding a drag conveyor which carries its load to the slurry tank.

**Feedwater.** During normal mill operation, feedwater consists of second- and third-cell condensates from the quadruple-effect mill evaporators and power plant turbine condensate. (See flow diagram, p 95.) The first cell condensate is oil-contaminated mill engine exhaust. It is processed through oil-removal filters and used in low-pressure boilers.

We tolerate sugar contamination of these mill evaporator condensates up to a maximum of 5 ppm. The conductivity cells with automatic dumping and alarm features control this. Future control will incorporate a more positive chemical-colorimetric device using a photoelectric system. In case of emergency, we use feedwater from a four-hour reserve supply. This serves while the source of sugar contamination is isolated and corrected.

Feedwater is boosted to a deaerating vertical heater operating at 12 psig with sufficient capacity for both new boilers. Second-stage heating to 355 F with 150-psig steam is provided in a horizontal high-pressure heater.

When the mill is not operating, make-up is supplied by a single horizontal evaporator using 40-psig steam with a capacity of 6000 net lb per hr.

Boiler water is conditioned entirely by internal treatment. Analysis and treatment follow a four-hour schedule.

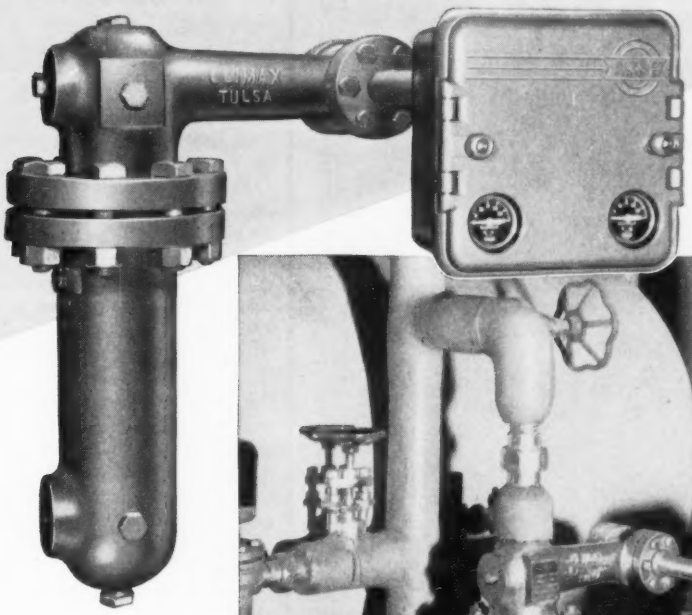
After three months of operation, using mill evaporator condensates slightly contaminated with sugar, internal inspection of the first boiler indicated excellent condition with no signs of corrosion or scaling caused by the sugar.

**Pressure reducing, desuperheating.** We had to install a two-stage pressure-reducing and desuperheating station. When electric energy demand drops sharply, new high-pressure turbine over-produces on extraction load. During this time, the new station provides steam to the 300 and 150-psi systems. The station is also necessary during the period between installation of the second boiler and operation of the proposed backpressure turbine. It may also act as a by-pass in case of any unforeseen power plant outage.

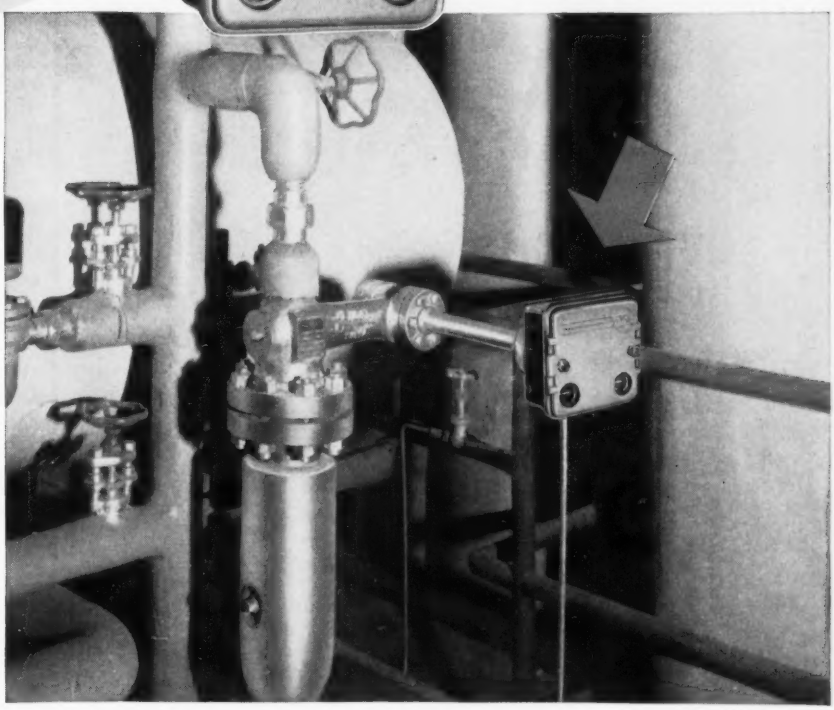
Both stages of reduction (from 850 to 300, and 300 to 150 psi) have a capacity of 140,000 lb per hr. Boiler feedwater, atomized by steam, is used for desuperheating.

**Condenser cooling water** is pumped from a skimming well with a capacity of 15 mgd. Two deepwell pumps, with a capacity of 4200 gpm each, pump

# When An External Cage Type Liquid Level Controller Is Indicated, Specify The . . .



## BS&B Type 71-06, Series 2!



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For Complete Information On The BS&B Type 71-06, Series 2, Or Other BS&B Liquid Level Controllers, Contact Your BS&B Sales Engineer — or Write To . . .

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In these days when there is so much discussion about radioactive fallout from atomic tests, it is just as important as ever to prevent fallout of fly ash from your stacks.
Laclede Chain Grate Stokers burn bituminous coal, without fly ash collectors, so efficiently that the provisions of all fly ash and smoke ordinances are met, regardless of the load fluctuation.
Build good public relations by reducing to a minimum your fly ash fallout. Save on initial cost, operating cost, maintenance cost and accessory cost by using Laclede Chain Grate Stokers that require no extra equipment to burn bituminous coal efficiently.
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## PUUNENE MILL

Continued from page 190

against a 125-ft head to supply the condenser. Water not used by the factory goes to an irrigation ditch at a higher level. Cooling water is first used in the power plant condensers, then in condensers for the factory evaporators and vacuum pans, then for washing sugar cane and finally for irrigation. The clear water from the well is at 76 F, contains 40 gr of salt per gal.

**The second boiler** further improves efficiency of the steam-generating plant by replacing all hrt boilers. In addition, a greater part of the steam produced in the two modern boilers is passed through the new turbine, increasing its output and using its extraction capacity to a maximum to supply steam for mill engines, auxiliaries and the older low-pressure turbines. The pressure-reducing station is used to meet factory requirements.

**Future installation.** We also plan to install a new backpressure turbine operating from 850 to 15 psi with the possibility of including automatic extraction at 150 psi. Unit will replace two old 750-kw backpressure turbines operating from 150 to 12 psi (installed in 1914). This will eliminate the continuous reducing and desuperheating, thus further improving efficiency.

## CARNOT CYCLE

Continued from page 93

engine producing shaft work. We can do this by considering the energy flow equations in Fig. 5. Here we have an energy source at the high temperature $T_1$. We have a natural receiver (atmosphere) at lower temperature $T_2$, and a refrigerated receiver at lowest temperature of $T_3$. Engine $A$ draws energy $Q_s$ from the source, produces shaft work $W_A$ and rejects unavailable energy $Q_r$ to the receiver at $T_2$.

Engine $B$ draws the same amount of energy $Q_s$ from the source, produces a larger amount of shaft work $W_B$ and rejects smaller unavailable energy $Q_{Br}$ to the refrigerated receiver at $T_3$.

Refrigerating engine (compressor) $C$ picks up energy $Q_{Br}$ from the refrigerated receiver at $T_3$ and with the aid of work input $W_C$ rejects energy $Q_{Cr}$ to the natural receiver, at $T_2$.

Now let's find how the three works $W_A$, $W_B$ and $W_C$ compare. Equation (1) states the relation between engine work output and heat energy input from the source and the thermal efficiency.

Equation (2) applies eq (1) to engine $A$; eq (3) to engine $B$. Eq (4) is the energy-flow balance about engine

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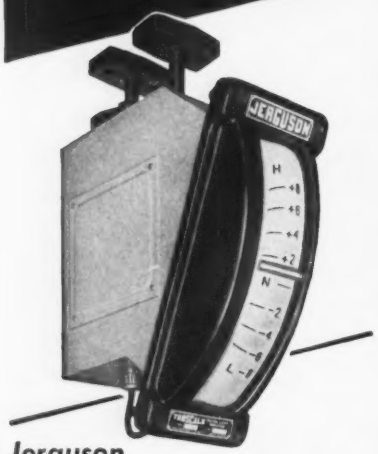
Face UP or DOWN

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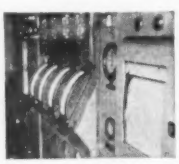
Remote Reading Gages

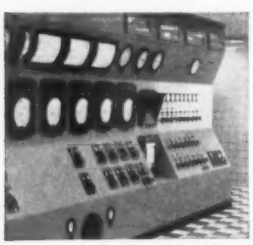
Have your Remote Reading Gages face up or down . . . to fit low or high installations. Inclined Truscales built with case and scale inclined either upward 35° or downward 24°.

Truscales give you accuracy of ½ of 1% of scale reading and full 180° visibility with scale markings directly on convex face.



Truscale Gages inclined upward in fireroom of SS Flandre

All types of warning signals: Flashing red scale, signal horns, lights and up to six repeaters.



Truscale Gage inclined downward on control panel at Florida Power Corp.

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# CARNOT CYCLE

Continued from page 192

*B*. Substituting for $W_B$ in eq (4) from (3) we get eq (5). Factoring out $Q_s$, we get eq (6). Eq (7) states the *COP* for engine *C*, solving for $Q_{Br}$ we get eq (8). Substituting from (6) we get eq (9). Solving for $W_C$ we get eq (10) and (11).

Subtracting eq (2) from (3) we get eq (12). Clearing we get eq (13) and (14). Substituting from (11) we get eq (15). This tells us that the additional amount of work produced by engine *B* over A exactly equals the amount of work input required by the refrigerating engine *C*. This is true for ideal engines working with reversible processes. Actual engines with their numerous irreversibilities would require a $W_C$ much greater than $W_B - W_A$.

**Irreversibility.** So far we have been studying the reversible Carnot cycle. Now let's see what effects practical irreversibilities—temperature drop, turbulence and friction—have on cycle performance. The most important effect is thermal irreversibility, that is, temperature drop. All experience teaches us that we can't transfer heat without a temperature difference—despite this, we assume reversible heat transfer at zero temperature differential in setting up the Carnot cycle. This gives us an ideal bench mark of unattainable perfection against which to measure practical cycles.

Fig. 3*a* indicates direction of temperature drops $\Delta T$ needed in a "practical" Carnot cycle to transfer energy during heat admission and rejection processes. Gas temperature must be less than source temperature, higher than receiver temperature. Amount of difference depends on the speed with which the heat must be transferred—the greater the flow, the greater the differential. Flow is also controlled by the amount of area of heat-transfer surface.

Fig. 3*b* shows the temperature curves for source $T_s$; for gas when receiving heat $Q_s$ from source, $T_{gs}$; for gas when rejecting heat $Q_r$ to receiver, $T_{gr}$; and receiver temperature $T_r$. Ideally the Carnot cycle could produce the net work $W$ shown by the gray area in cycle *1-2-3-4*. But, because of the temperature drops, the gas actually works on the cycle outlined by the heavy curves and produces the smaller net $W$ defined by the cross hatching. This P-V diagram shows the incentive for keeping temperature differentials as small as possible.

Fig. 3*c* shows the same story on T-S coordinates. The gray area $Q$ shows the ideal amount of heat convertible to $W$ for the given $T_s$ and $T_r$. But the

(*Continued on page* 198)


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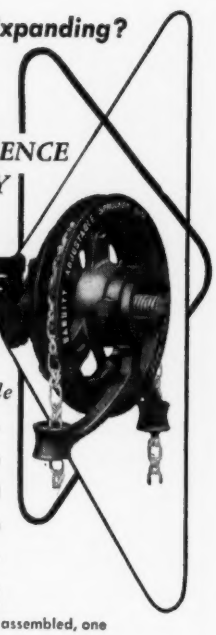

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There's still nothing simpler or more efficient in power line service than this Wilcox Self-Sealing Gasket which has served industry so well over the years. The U-shaped metal outer cover is packed with a resilient filling (usually rubber or asbestos). Pressure exerted on this elastic filling forces it into the cover, putting force against the adjacent flange surfaces. Thus, internal pressure that tends to blow ordinary gaskets makes the Wilcox Gasket tighter in the joint. Available with covers of copper, lead, tin, aluminum, monel, stainless steel, etc. in all sizes—standard or special.

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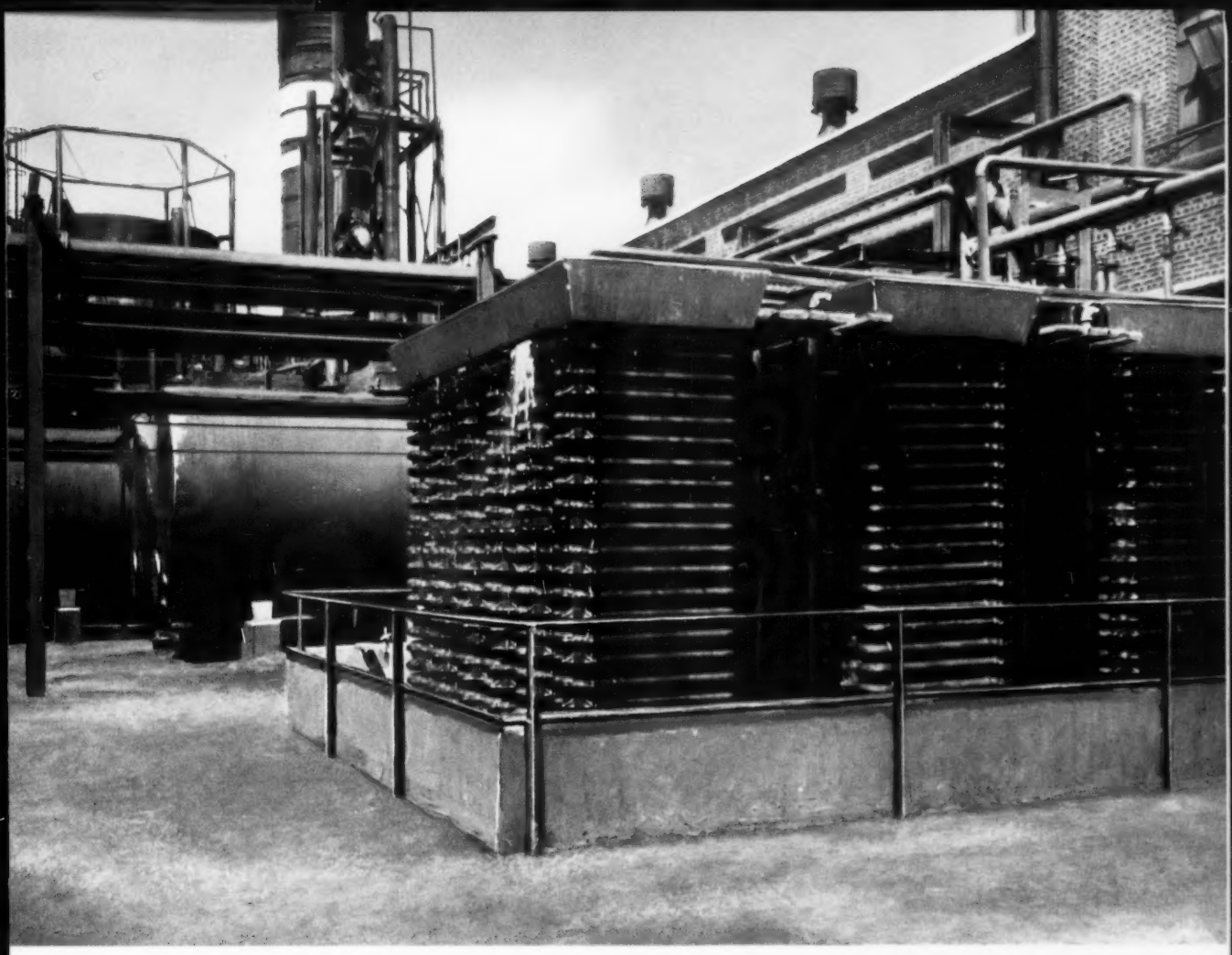

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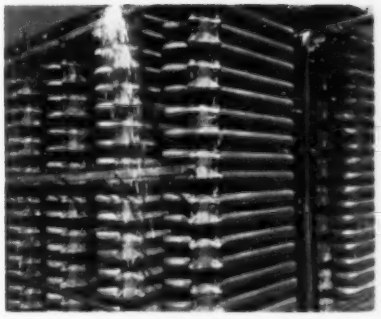
## that signals CORROSION PREVENTION



Nalco blue on these exposed cooling unit coils is the visible evidence of effective corrosion prevention at work. Nalco System chemicals used in this installation form a tough protective film of characteristic blue color on all ferrous metal surfaces. The metal is literally sealed off from direct contact with water, air and fumes, yet the film itself will not impair heat transfer efficiency.

Similar Nalco protection for your plant can cut maintenance costs and protect you against unscheduled shutdowns that are frequently caused by damaging corrosion. Call your Nalco Representative for some facts and figures on Nalco System protection and economy.

**NATIONAL ALUMINATE CORPORATION**
6208 West 66th Place Chicago 38, Illinois
Telephone: POrtsmouth 7-7240
CANADA: Alchem Limited, Burlington, Ontario
NORTHWESTERN UNITED STATES, HAWAII AND ALASKA:
The Flox Company, Inc., Minneapolis 3, Minnesota
ITALY: Nalco Italiana, S.p.A.
WEST GERMANY: Deutsche Nalco-Chemie GmbH
SPAIN: Nalco Espanola, S.A.

THE *Nalco*® SYSTEM . . . *Serving Industry through Practical Applied Science*

# NEW

*Introducing a unique concept of induced draft equipment design*

## CLARAGE TYPE DN DYNACURVE FANS

You'll find this new Clarage product has many advantages in store for you. For example: Minimum floor space and height requirements . . . Low first cost, installation cost, and operating cost . . . High efficiency over a wide performance range . . . Fan wheel built with 36 aerodynamically curved blades and tapered rims . . . Exceptionally rugged construction fully equal to the most exacting assignments. Obtain full information on Type DN Dynacurve Fans. Write today for Catalog 905. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

**CLARAGE** ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

# ALL-PURPOSE SAFETY VALVE

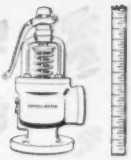
## REDUCES YOUR INVESTMENT FOR STEAM GENERATOR PROTECTION...

THE TYPE 1511 CONSOLIDATED SAFETY VALVE is today's best value in all-purpose safety valves for steam generator service. It is precision-built yet costs less than other valves for similar applications. Its high efficiency reduces the number of safety valves needed per boiler—saves maintenance time and costs. Compactness of design reduces the amount of space and head room required for installation and to operate the lifting lever.

There is no need to carry a large inventory of Consolidated Safety Valves. Stocks of valves are maintained at convenient warehouses where they can also be set to your specific requirements before delivery.

Since the Type 1511 was first introduced, its functional perfection and economy have unqualified acceptance from the power industry. Write for complete details about this efficient valve. Ask for Bulletin 730.

*Type 1511 Consolidated Cast Iron Safety Valve. Sizes:* 1½" thru 6". Full range of orifices. *Pressures:* Up to 250 psi. *Temperatures:* Up to 450° F.



**COMPACTNESS**
saves space and headroom and permits the use of smaller, more economical discharge piping.

**LOWERS THE COST**
per pound of steam discharged because maximum capacity is designed into minimum flange size. The size and/or number of safety valves per boiler are reduced.

**ALIGNMENT IS BETTER**
blowdown adjustment is easier and operation is finer because the valve has an integral double-guided combination adjustment ring and disc guide.

**POSITIVE TIGHTNESS**
is assured because the seat is machine-lapped to optical flatness.

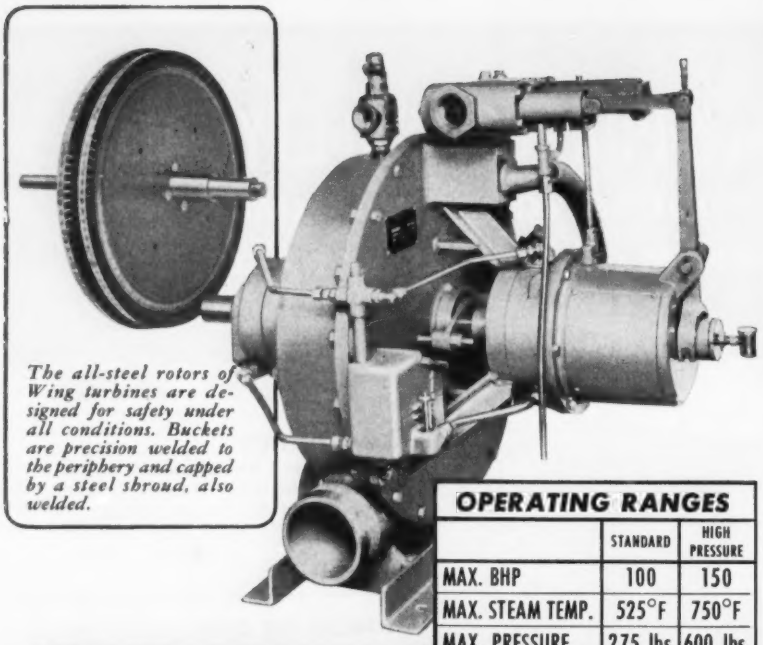
**STABLE PERFORMANCE**
is certain because the spring is exposed, and the blowdown control is uniform.

**In Canada:** *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

# CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*



*The all-steel rotors of Wing turbines are designed for safety under all conditions. Buckets are precision welded to the periphery and capped by a steel shroud, also welded.*

**OPERATING RANGES**

| | STANDARD | HIGH PRESSURE |
|---|---|---|
| MAX. BHP | 100 | 150 |
| MAX. STEAM TEMP. | 525°F | 750°F |
| MAX. PRESSURE | 275 lbs. | 600 lbs. |
| BACK PRESSURES to | 50 lbs. | 50 lbs. |
| SPEEDS to | 4000 RPM | 4000 RPM |

**BUILT-IN RUGGEDNESS**

WING STEAM TURBINES have been manufactured by L. J. Wing Mfg. Co. for nearly half-a-century. During that time these sturdy, dependable prime movers have been giving excellent service in thousands of industrial and marine installations under the most exacting conditions of operation. They are ideal for operating compressors, generators, fans, mixers and many other types of equipment. Reliability is inherent. Use the coupon to get further details.

**L. J. Wing Mfg. Co.** 50 Vreeland Mills Road, Linden, N. J.
*Factories: Linden, N.J. and Montreal, Can.*

**· Wing · AUXILIARY TURBINES**

WING REVOLVING HEATERS

WING DRAFT INDUCERS

WING MOTORIZED BLOWERS

WING TURBINE BLOWERS

P-8
L. J. Wing Mfg. Co.,
50 Vreeland Mills Rd., Linden, N.J.
Please send copy of Auxiliary Turbine Bulletin T-54.
Name .....
Firm .....
Address .....
City ..... Zone ..... State .....


## CARNOT CYCLE

Continued from page 194

cross-hatched area shows the actual amount attainable. The corresponding unavailable energy is then $Q_r$ beneath the lower heavy line. The ideal $Q_r$ would be the area under process *1-2*, an area smaller than the actual $Q_r$.

Now, let's see what happens in the reversed Carnot cycle as a refrigerating engine. Fig. 3*d* shows the temperature differentials $\Delta T$ needed at source and receiver. Here the gas temperature needs to be higher than the receiver on the high-temperature end of the cycle, lower than the source on the low-temperature end—just the reverse of the engine cycle, as far as general temperature level is concerned.

Fig. 3*e* shows the effect on the P-V cycle. The gray area shows the ideal net work input $W$ needed to run the cycle, but the larger cross-hatched area gives the actual work needed to run the cycle between the same source and receiver temperature limits.

Fig. 3*f* shows the relations on *T-S* coordinates. $Q$ is the heat equivalent of the net work input $W$ needed to run the refrigerating cycle. The gray area shows the ideal amount needed; the cross-hatched area shows the actual larger amount needed because of the temperature differentials during the heat transfers. The actual cycle withdraws a smaller amount $Q_c$ from the refrigerated area per cycle to deliver to the receiver at temperature $T_r$, than the ideal cycle.

So we see in both the direct engine and reversed refrigeration cycles, the necessary temperature differentials cause a decrease in cycle overall performance.

*Next part deals with mechanical irreversibility, entropy of energy and the ideal cycle.*

## WOOD DECAY

Continued from page 79

of the dissolved solids in the circulating cooling water. Because it is clean and easy to handle, labor is not paid a premium for handling this treated wood.

**Creosote** has compiled an effective record of preventing decay. Cleanliness of the treated wood is exceptionally high. Correctly processed wood surfaces are dry of creosote oil, leave only a slight oily film. This is not harmful to the cooling system but it does mean that labor often charges a premium for handling creosote-treated cooling-tower lumber.

Creosoted aquaducts, carrying water for human consumption, irrigation and power plant use, have given satisfactory

# Get low-cost boiler feed from oil-bearing condensate...

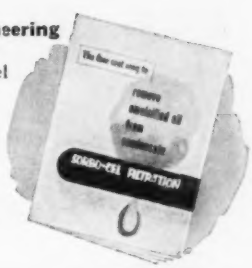
## WITH SORBO-CEL FILTRATION

**Sorbo-Cel filtration systems** are compact . . . easy to operate with unskilled labor.

2¢—5¢ per 1000 gallons is all it costs you to reclaim oil-contaminated condensate with Sorbo-Cel® filtration. Sorbo-Cel can reduce oil content to less than 0.1 ppm . . . also removes rust, scale and other suspended solids. Sorbo-Cel not only saves water, but materially reduces boiler tube maintenance caused by oil and suspended solids in the feed water. And proper lubrication need not be sacrificed to insure oil-free water.

Sorbo-Cel is a diatomite powder specially processed to provide the most efficient and economical filtration of oil-contaminated water . . . for boiler feed or other process applications. It can be used with practically every type of pressure filter and requires no additional chemicals.

**Free! Information and Engineering Service.** Write today for your free copy of the new Sorbo-Cel brochure. If you desire, a Sorbo-Cel engineer will call for appointment to visit your plant. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.




JOHNS-MANVILLE JM PRODUCTS

**Johns-Manville SORBO-CEL®**

# Here's POWER to clean tubes from 1/2" to 2" QUICKLY

Rotojet Junior Tube Cleaners are unusually powerful for their size and weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Their convenient size, speed, and ease of operation offer a marked contrast with external cleaners costing many times more.

An air valve directly behind the Rotojet motor permits one-man operation. Very little headroom is required, and either vertical or horizontal tubes can be cleaned.

Simplicity of Rotojet design and precision construction assure long service, efficient use of power, and freedom from trouble. Economical brushes, cutters, and scrapers meet practically any requirement.

*Send for Bulletin J-410.*

Expanding scraper and replaceable element.

Expanding brush and replaceable element.

Sectional wire brush.

Air valve for one-man operation.

# ROTOJET®
## Junior TUBE CLEANERS

ELLIOTT COMPANY - ROTO DIVISION
*Tube Cleaner Specialists Since 1910*
153 Sussex Avenue, Newark, N. J.


## WOOD DECAY

*Continued from page 198*

use for many years—and without imparting taste, odor or scale-forming properties to the water.

**Other lumber.** Not all cooling towers are constructed of redwood. Other species of wood are acceptable and have been used. A number were built using pressure-creosoted Douglas fir and Southern yellow pine. One oil company in Texas used these materials for several towers constructed during 1933 to 1936.

American Wood-Preservers' Association reported in 1955 that only 0.5% of the wood in these towers was effected by decay.

There is widespread interest in the use of treated lumber to construct and repair cooling-tower wood. It is a good solution to the wood-decay problem. But it is not a cure-all for cooling-tower operating problems. Other aspects of cooling-tower design and operation cannot be neglected. Even with treated wood, water conditioning is needed to prevent scaling, corrosion, fouling and other troubles that can cut down the efficiency of cooling-tower installations.

## More FREE LITERATURE

*Begins on page 159*

**10** **Centralized control** of widespread operations is described in 12-p illustrated bulletin 240-P2A. Bulletin contains illustrations, diagramatic and wiring drawings and typical installation photos. Builders-Providence, Inc, 345 Harris Ave, Providence 1, Rhode Island.

**11** **Control and regulation** of flow of steam and other fluids is discussed in 4-p illustrated bulletin 1011. Selection data with photographs is presented on three principal types of main valves and pilots. Includes suggested applications and a steam capacity table for selection of main valve size. Spence Engineering Co, Inc, Walden, N. Y.

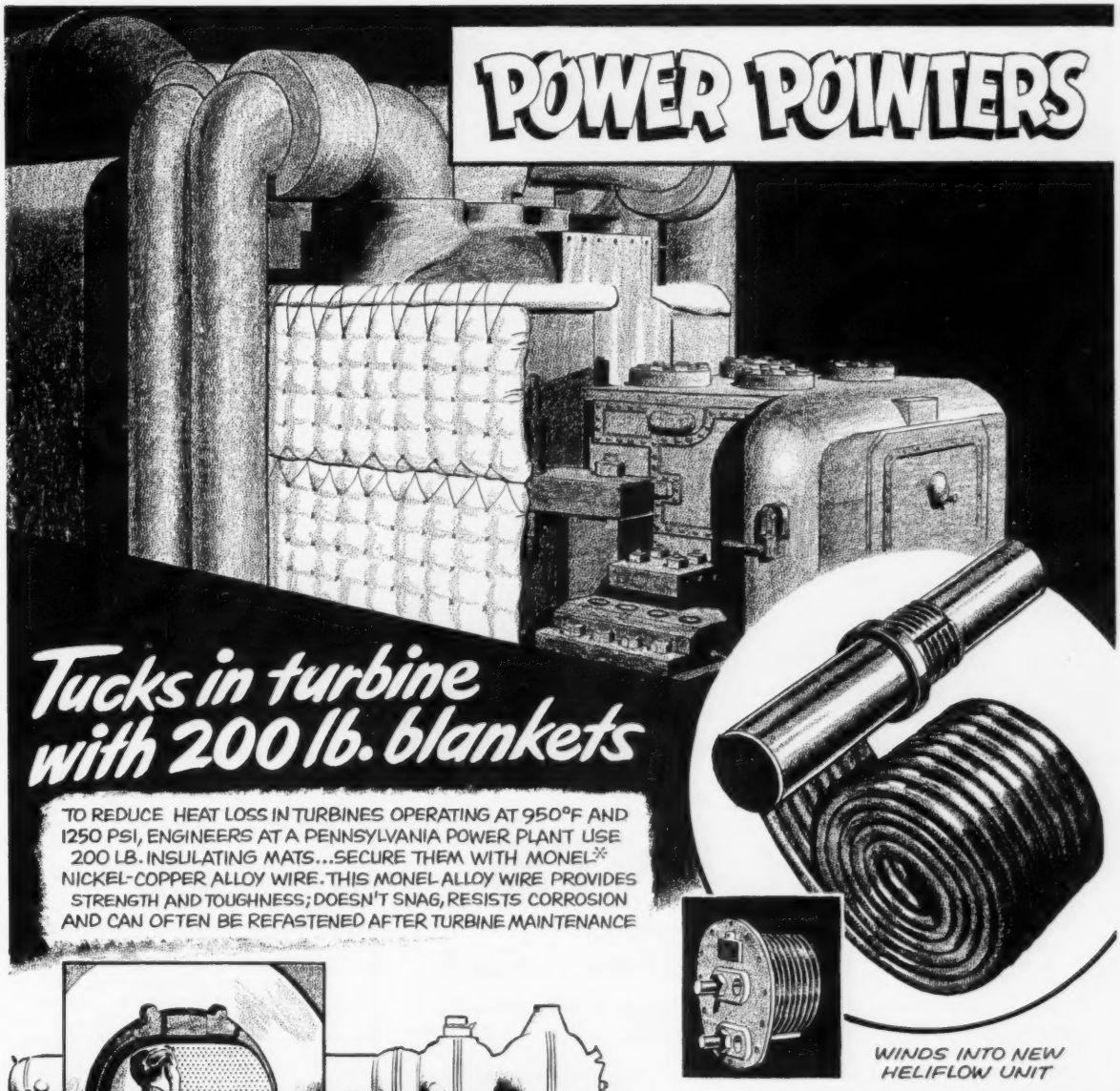
**12** **Industrial thermowells** for protection of temperature sensing elements are subject of 4-p illustrated bulletin D. Specs for individual types are listed in chart form with corresponding ordering instructions. Thermo Electric Co, Inc, Saddle Brook, N. J.

### ELECTRICAL EQUIPMENT

**13** **Closed-circuit television** equipment is subject of 10-p illustrated bulletin GEA-6382A. Contains description, principles of operation, applications and specs. Also includes list of accessories available. General Electric Co, Electronics Park, Syracuse, N. Y.

**14** **Electrical surface raceway** is reviewed in an illustrated 4-p bul-

# POWER POINTERS

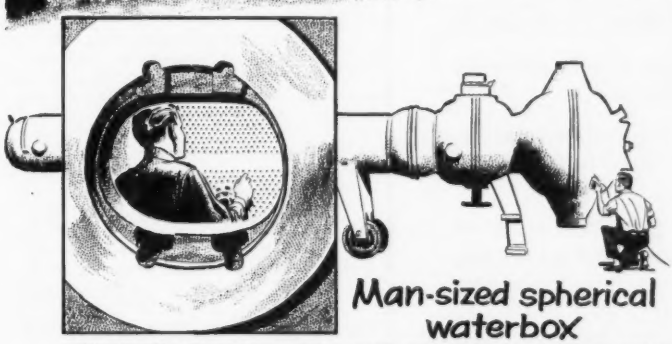


## Tucks in turbine with 200 lb. blankets

TO REDUCE HEAT LOSS IN TURBINES OPERATING AT 950°F AND 1250 PSI, ENGINEERS AT A PENNSYLVANIA POWER PLANT USE 200 LB. INSULATING MATS...SECURE THEM WITH MONEL* NICKEL-COPPER ALLOY WIRE. THIS MONEL ALLOY WIRE PROVIDES STRENGTH AND TOUGHNESS; DOESN'T SNAG, RESISTS CORROSION AND CAN OFTEN BE REFASTENED AFTER TURBINE MAINTENANCE



WINDS INTO NEW HELIFLOW UNIT



## Man-sized spherical waterbox

FEEDWATER HEATERS — WITH WATER-BOXES BIG ENOUGH TO HOLD A MAN — FEED TWO OF THE LARGEST BOILERS IN THE WORLD. TUBE BUNDLES FOR THE SPHERICAL-HEAD HEATERS — EACH 30 FT. LONG AND 40 IN. IN DIA. — ARE MADE OF MONEL ALLOY. THE HIGH STRENGTH OF MONEL ALLOY IN THE 500°F RANGE PERMITTED THE USE OF RELATIVELY LIGHT (18 GAUGE) TUBING TO HANDLE WATER PRESSURES UP TO 3,000 PSI

## SNAIL-SHAPED MONEL BUNDLE BOOSTS HEAT TRANSFER 40%

BY BENDING MONEL NICKEL-COPPER ALLOY TUBING INTO A SNAIL-SHAPED BUNDLE OF PANCAKED COILS, GRAHAM MANUFACTURING CO. PACKS A LOT OF HEAT TRANSFER AREA IN A SMALL SPACE. THE HELIFLOW DESIGN ACTUALLY BOOSTS HEAT TRANSFER AS MUCH AS 40% OVER CONVENTIONAL UNITS OF THE SAME VOLUME. MONEL ALLOY TUBE BUNDLE ABSORBS EXPANSION STRESSES AND RESISTS CORROSION. IN SOME UNITS, THESE MONEL ALLOY COILS HANDLE UP TO 15,000 PSI!

## NEED HELP ON A METAL PROBLEM?

TWO HEADS ARE BETTER THAN ONE. WHY NOT SHARE YOUR METAL PROBLEM WITH INCO. AS A STARTER — SEND FOR "ENGINEERING PROPERTIES OF MONEL AND 'K' MONEL". ONE OR BOTH OF THESE TWO NICKEL-CONTAINING ALLOYS MAY BE JUST WHAT YOU'RE LOOKING FOR

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK NICKEL ALLOYS

*Registered Trademark

# HYDRANTS

- Best for plant fire protection
- Types and sizes for all requirements

Two reasons why Darling fire hydrants can give your facilities the protection you need . . . instantly . . . *when you need it!*

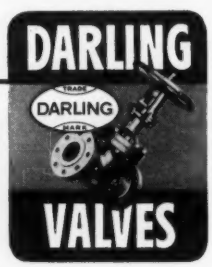
*First*, you can locate Darlings to greatest possible advantage because there are sizes and types for every conceivable installation requirement and condition.

*Second*, these modern hydrants are unmatched for advanced operating features. The Darling B-50-B development means ball bearing operation combined with "O" ring seals. Result: packless, dry-top hydrants. Operating threads *stay* lubricated and water can't reach them! Operation is far easier, faster, surer . . . and maintenance is avoided.

Send for Bulletin 5403. Better still, let us send an engineer to analyze your requirements and make specific recommendations.

**DARLING VALVE & MANUFACTURING CO.**
**Williamsport 8, Pa.**

*Manufactured in Canada by*
*The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.*




## More FREE LITERATURE

*Begins on page 159*

letin 31-C-62. Contains photos of finished installation and series of drawings showing mounting and wiring. National Electric Products Corp, Two Gateway Center, Pittsburgh, Pa.

**15** **Power for protection** is subject of bulletin D721. Complete line of electric sets is listed with hp and kw ratings. Caterpillar Tractor Co, Advertising Div, Peoria, Ill.

**16** **Motors, gearmotors,** motor-generator sets, motor controls and complete packaged mechanical and electronic adjustable-speed drives are described in 8-p illustrated bulletin A-2501. Reliance Electric and Engineering Co, 24701 Euclid Ave, Cleveland 17, Ohio.

**17** **Variable transformers** for high frequency application are described in 28-p illustrated bulletin P257H which offers features, ratings and complete data. Superior Electric Co, Dept 257, 83 Laurel St, Bristol, Conn.

**18** **Instrument transformers,** their theory and operation, are described in 24-p bulletin 61S8528. Presents many ASA standards in interesting easy reference form and shows typical current and potential transformer performance curves. Ratio-phase angle correction chart is included. Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

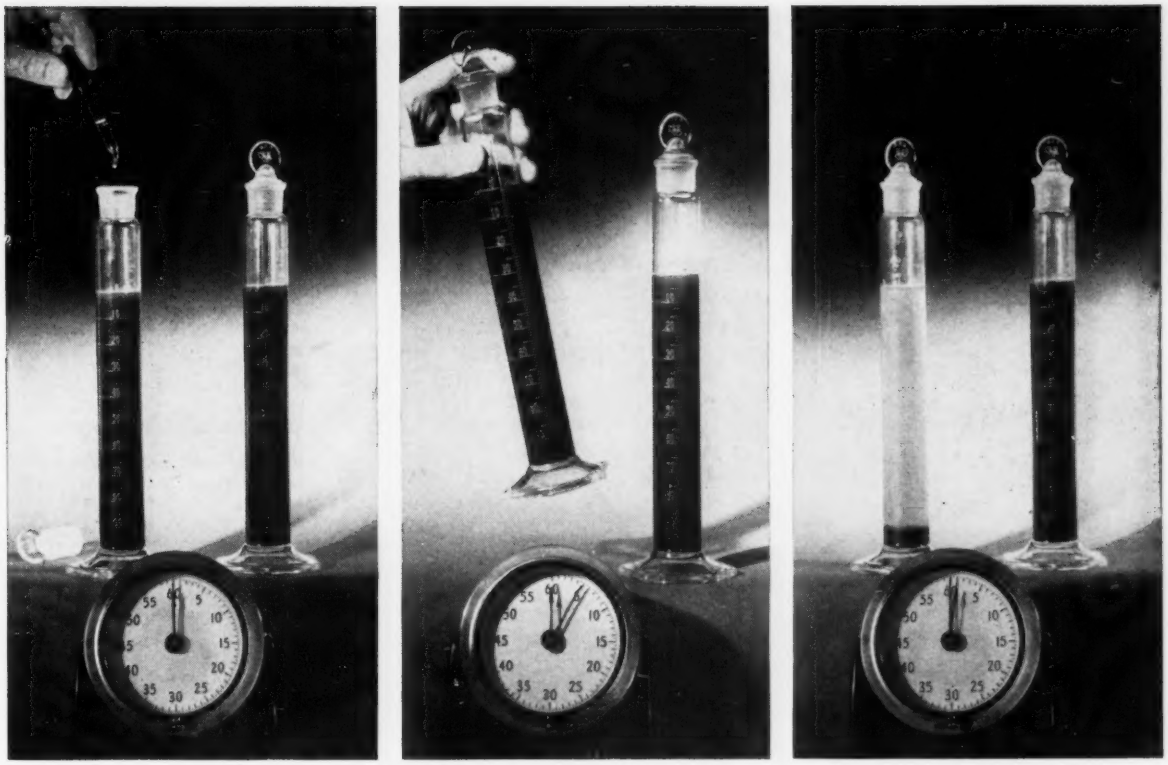
### MAINTENANCE EQUIPMENT & MATERIALS

**19** **Ducting systems,** of welded polyethylene for handling corrosive acid and alkali fumes are subject of this bulletin. Contains photos showing installation in operation, plus details for major components and specs. American Agile Corp, Box 168, Bedford, Ohio.

★ **Rust and corrosion** in steam lines, return lines, radiators and steam-heated processing equipment is discussed in 2-p bulletin M-A. Causes of rust/corrosion and action of water treatment are explained. ★Request direct on company letterhead. The North American Mogul Products Co, Standard Bldg, Cleveland 13, Ohio.

**20** **Liquid protective coating** for concrete floors is described in 4-p bulletin. Contains specs and an application table. L Sonneborn Sons, Inc, Dept BB, 404 4th Ave, New York 16, N. Y.

**21** **Low-soluble cement** base lining for interiors of steel water heaters, tanks, vats and other vessels handling bulk liquids is subject of 4-p illustrated bulletin PF-17. Contains photos of on-the-job applications and a tabular section to enable a prospective user to calculate the amount needed. Pocono Fabricators, Inc, East Stroudsburg, Pa. (*Continued on p* 204)



*Demonstration:* Add Separan 2610 . . . mix . . . in a few seconds, solids settle . . . compare with untreated solids.

# New flocculating agent Separan 2610 clears process and waste water in record time

New flocculant proves to be faster and more economical answer to many old problems in process water and waste treatment operations. Separan 2610® speeds up settling and filtration rates . . . brings many other improvements to liquid-solid separations!

### PROVEN APPLICATIONS

***Process water treatment*** – improves throughput and performance in hot and cold lime softeners, chemical flocculation units!

***Sewage***–speeds dewatering of digested elutriated sewage sludge!

***Oily waste disposal*** – improves floc blanket flotation on refinery water effluent flotation unit!

***Foundry waste***–reduces stream pollution and provides cleaner recycle water!

***Pulp & paper waste***–increases solids recovery, lowers sewer loss!

***Coal washing***–improves fines recovery, increases throughput of settling unit!

***Electroplating***–settles solids in combined cyanide, chrome and acid wastes; speeds filtering!

***Chemical wastes***–improves solids recovery; less material loss!

### EXAMPLES OF RESULTS

Separan 2610 was applied at 0.25 ppm to a cold lime softener supplying cooling tower make-up water. The sludge blanket became stabilized, effluent turbidity was reduced from an average 10 ppm to less than 5 ppm, and the unit operates more efficiently. Flocculant savings with Separan 2610 exceed $110 per month on a throughput that averages 900 gpm.

Another plant uses Separan 2610 in dewatering of digested elutriated sewage sludge on vacuum filters. This application has brought a 24% increase in filter capacity and a 20% reduction in total chemical flocculant cost.

In oil refineries, similar improvements are being experienced in flotation units for clarification of combined oily wastes. By adding 0.5 ppm Separan 2610, along with alum, to waste water in a flotation unit, plants have improved floc blanket stability and reduced the oil content of the effluent.

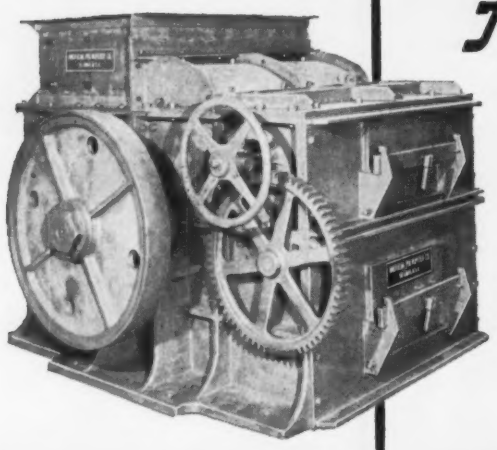
### MANY APPLICATIONS HAVE BEEN TESTED

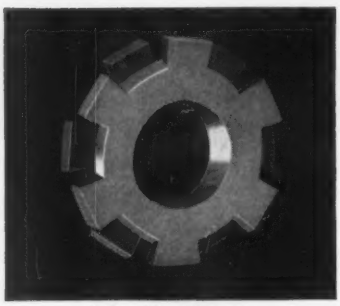
Separan 2610 has shown excellent results in many waste and process water applications. It is an organic flocculating aid that is easy to prepare and apply, noncorrosive, and that presents no hazard in normal handling and industrial use. Samples and technical assistance are available by writing us. For further data, request one of our new booklets on Separan 2610 in "Waste and Sewage", "Water Treatment", "Coal Industry", or "Pulp and Paper". THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. SC1321J-2.

YOU CAN DEPEND ON DOW

# BETTER COAL CRUSHING CONTROL BECAUSE IT'S BUILT BETTER . . .

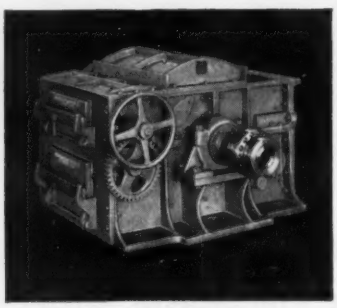
American ROLLING RING COAL CRUSHERS





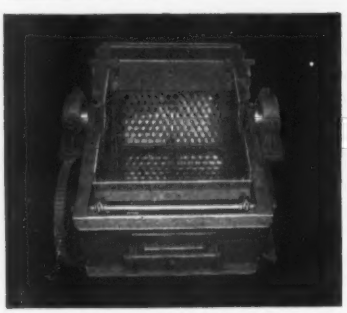
**1 Patented Shredder Ring**

American-originated feature that splits coal instead of smashing it—for uniform sizing, minimum fines. Result: Americans run at slow speeds, with savings in power and maintenance. No cams, shear pins, toggles.



**2 Heavy-Ribbed Steel Frame**

Bearing pedestals are cast integrally with lower side frames. Sectional design for easy dismantling . . . abutting joints accurately machined and bolted together for dust-tight fit.



**3 Completely Lined Crushing Chamber**

Heavy, renewable liners . . . sectional for easy plate-at-a-time replacement . . . engineered to offer life-time protection to the frame.

**4 Complete Accessibility to Adjustment and Parts**

All adjustments external—even with crusher in motion. Rotor easily reached by removing top section. Rings readily reversed or replaced. Liners quickly reached, too, for periodical inspection.

*WRITE for Coal Crushing Bulletin*

American PULVERIZER COMPANY

*Originators and Manufacturers of Ring Crushers and Pulverizers*

1349 MACKLIND AVE. • ST. LOUIS 10, MO.


# More FREE LITERATURE

*Begins on page 159*

## METALS AND ALLOYS

**22** **Physical properties** of zirconium and the Zircaloys and the mechanical properties of three different tempers of these metals is subject of *Special Analysis Memorandum* 112. Superior Tube Co, 1778 Germantown Ave, Norristown, Pa.

**23** **High - temperature alloys,** their physical properties, applications and shape availability are described in 4-p bulletin DB-52-250. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

## METERS AND INSTRUMENTS

**24** **Sonic gas analyzer** is subject of 3-p illustrated bulletin 175. Contains diagrams, specs, other features. National Instrument Laboratories, Inc, 6108 Rhode Island Ave, Riverdale, Md.

**25** **Hardness tester** for testing any size, shape, type of metal is described in 4-p illustrated bulletin. Photos show on-the-job applications. Newage Industries, Inc, 222 York Rd, Jenkintown, Pa.

**26** **Pulse calibrator** is described in 4-p illustrated bulletin. Describes operation of the unit, illustrating and explaining actual waveforms obtained from different applications of unit. Burroughs Corp, Electronic Instruments Div, 1209 Vine St, Philadelphia, Pa.

**27** **Electrodes** for laboratory and portable pH meters are subject of 8-p bulletin 86-5. Bulletin is made up in simplified chart form, completely indexed and illustrated—designed to guide users in selecting correct pH electrodes. Beckman Instruments, Inc, Scientific Instruments Div, Fullerton, Calif.

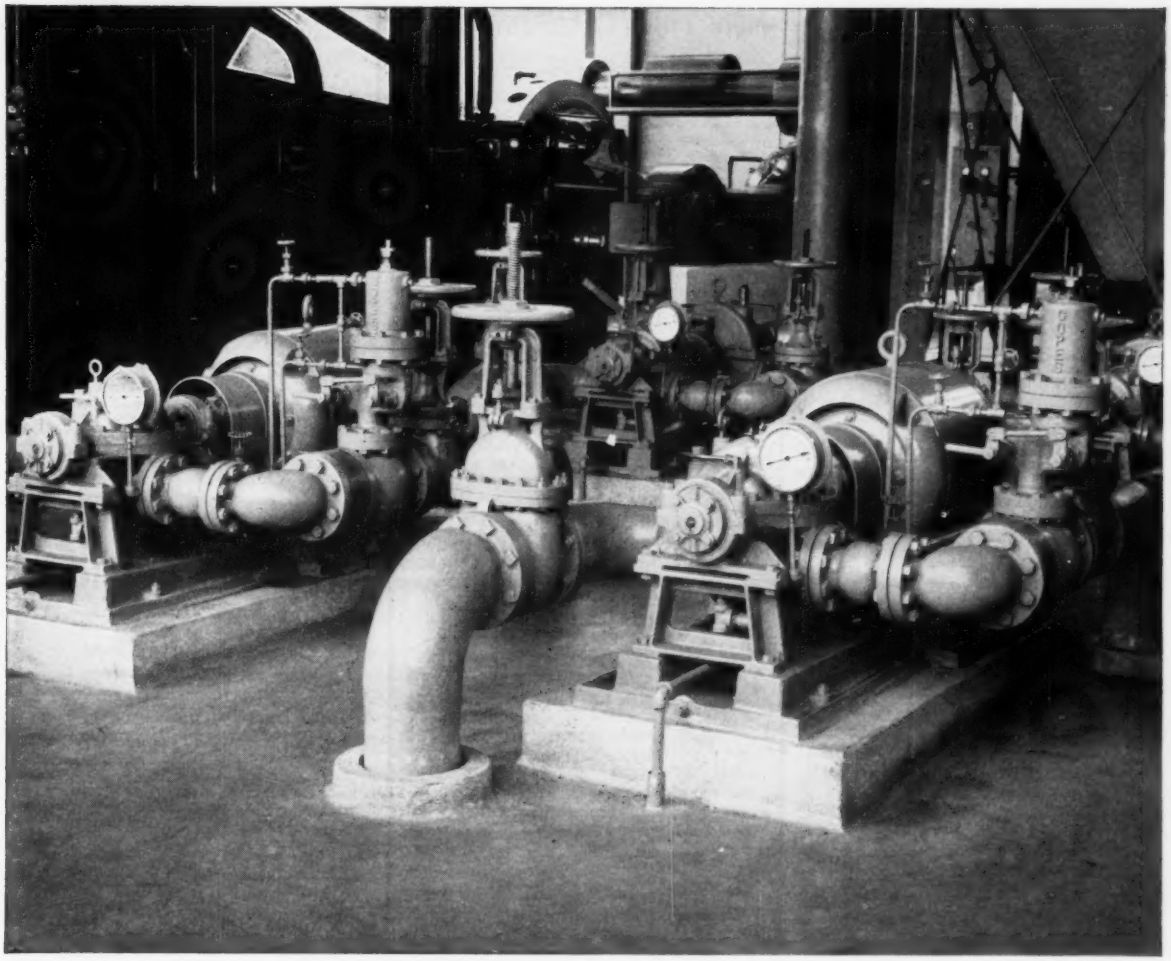
**28** **Linear accelerometers** are described in 2-p illustrated bulletin LF-MF-6-57. Includes general specs and an overall dimension chart. B&F Instruments Inc, 4732 N Broad St, Philadelphia 41, Pa.

**29** **Flowmeters** are described in 4-p bulletin 110. Selection wheel, included in bulletin, serves to indicate pressure and temperature limitations of instruments as well as their flow capacity range. **Brooks Rotameter Co,** Lansdale, Pa.

## NUCLEAR ENERGY

**30** **Nuclear reactor control** is subject of 4-p illustrated bulletin S-901-1. Contains photos, diagrams, performance information and specs. Minneapolis-Honeywell Regulator Co, Industrial Div, Philadelphia 44, Pa.

**31** **Filters and filtration** systems for use in nuclear power and research applications are described in 4-p

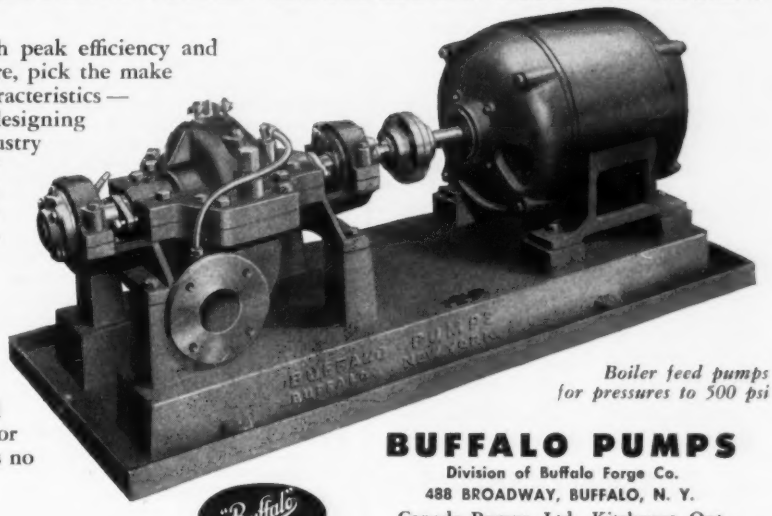


*"Buffalo" Type RR Pumps on boiler feed at a large auto plant*

# "BUFFALO" – THE PUMPS THAT DON'T MIND BEING IN HOT WATER AND UNDER PRESSURE!

In selecting boiler feed pumps of both peak efficiency and year-after-year durability, under pressure, pick the make with the 80-year record for these characteristics — "Buffalo". This long experience in designing and building centrifugal pumps for industry has resulted in present-day "Buffalo" Pumps with every feature for maximum delivery at least power input — and for continuous service with negligible maintenance.

"Buffalo" Type RR two-stage and four-stage pumps have the typically efficient, balanced "Buffalo" impellers — the oversize bearings and shafts — the rugged casings with simply formed water passages and deep 8-ring stuffing boxes. Write for Bulletin 980 and see why we say there's no better buy!



*Boiler feed pumps for pressures to 500 psi*

**BUFFALO PUMPS**

Division of Buffalo Forge Co.
488 BROADWAY, BUFFALO, N. Y.
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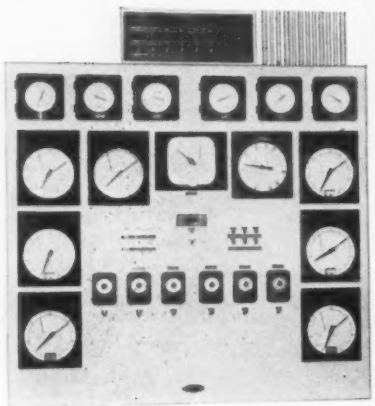
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

# 6-Tank *Automatic* Demineralizer

Power boilers in a Pacific Northwest pulp mill are supplied a potential 100% silica-free makeup from a Multibed Demineralizer custom designed by our engineering staff. Controlled by the panel (below) the completely closed system requires no repumping. Consisting of three 9 ft. dia. cation exchangers, in series with three 9 ft. dia. anion exchangers, the plant can deliver a maximum 1200 gpm to the 1200 psi boilers.



## 7-FEATURE CONTROL PANEL

1. Automatically regenerates equipment as required.
2. Records flow thru each tank.
3. Indicates water quality from each tank.
4. Records total plant flow.
5. Records total plant water quality.
6. Alarms malfunction or exhaustion of any unit and removes it from stream.
7. Provides optional manual operation.

## GOT A WATER TREATMENT PROBLEM?

Prolonging the service life of your power boilers and turbines means lower operating costs and better quality control. H.M.M. custom design, engineering and manufacturing services are flexible enough to adapt our equipment to your power or process water problem. Contact us on your water purification needs.

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# More FREE LITERATURE

Begins on page 159

illustrated bulletin 54-102. Discusses characteristics of various filter types and media used in the nuclear field and lists 15 of the principal types of nuclear power applications for which company produces filter units. Cuno Engineering Corp, South Vine St, Meriden, Conn.

### PIPING, VALVES, FITTINGS AND SPECIALTIES

**32** **Chemical relief valves** and back-pressure valves are described in 4-p illustrated bulletin 357. Gives complete specs including capacities of four standard sizes—¼, ½, ¾ and 1 in. Dimensions and materials of construction are also included. Milton Roy Co, 1300 E Mermaid Lane, Philadelphia 18, Pa.

**33** **Corrosion-resistant fittings** are subject of 21-p illustrated bulletin. Includes specs, photos, diagrammatic charts showing installation. Horace T Potts Co, Erie Ave & D St, Philadelphia 34, Pa.

**34** **Check valves** which can be combined with any standard pipe fitting to form a complete check unit, are described in illustrated 8-p bulletin. Illustrations show applications; pressure and temperature ratings are listed. Durabla Mfg Co, Inc, 114 Liberty St, New York 6, N. Y.

**35** **Steel piping** is subject of 4-p data folder TDC-138. Includes two tables—one listing dimensional data, the other listing specs. The Babcock and Wilcox Co, General Sales Office, Beaver Falls, Pa.

**36** **Refrigeration valve** catalog W-4-S section M, introduces new products in line; illustrates and describes standard and special type valves, filters and driers. Controls Company of America, 2450 N 32nd St, Milwaukee 45, Wis.

**37** **Lubrication fittings** are described in 31-p illustrated bulletin 38-23. Bulletin also lists fittings which have been developed for special purposes such as relief, measuring and drive fittings. Stewart-Warner Corp, Alemite Div, 1826 Diversey Pkwy, Chicago 14, Ill.

**38** **Automatic shut-off valves** for use in oil, water, air or other lines, to shut off supply in case of a break, are described in illustrated 1-p bulletin 8-A. Pictures and briefly describes two designs offered and lists sizes available. Schutte and Koerting Co, Dept V-C, Cornwell Heights, Bucks County, Pa.

**39** **Impulse steam trap** designed especially to handle heavy condensate loads is described in 4-p bulletin. Gives sizes, capacities; lists typical applications and shows dimensions, weights and prices. Yarnall-Waring Co, Chestnut Hill, Philadelphia 18, Pa.


**Now—a clear, simple guide to**

*nuclear power plant*

**design, construction, operation**

You can quickly bridge the gap between power engineering with conventional fuels and the more complex demands of the nuclear field with this simple guide. It gives you the fundamentals of atomic and nuclear physics in a picture-clear treatment. You get all the special requirements of reactor and nuclear power cycle design. Design procedure for a typical reactor is shown, and descriptions and data on existing U.S. reactors round out the book.

*Just Out!*

## NUCLEAR POWER ENGINEERING

By HENRY C. SCHWENK
Henry Pratt Company
and ROBERT H. SHANNON
United Engineers and Constructors, Inc.
Edited by B. G. A. SKROTZKI
Engineering and Management Editor, *Power*

*319 pages, 6 x 9, 131 illustrations, $6.50*

**Based on a Nuclear Energy Study Course which appeared in Power** the book supplies an essential grounding in the physics of atomic particles—their nature, reaction, fusion and fission properties, and how propagation of fissioning by a chain reaction lays the basis for nuclear reactor operating principles.

**Design is covered** in discussion of all the considerations affecting the **construction and operation of the reactor and its auxiliaries.** In addition, the step-by-step **procedure** of design is outlined. Reactor materials and components, plant location, safety, economics, data on existing reactors, and other phases of the problem are included in a comprehensive treatment.

**SOME TOPICS COVERED:**
—neutron reactions
—fuel preparation
—leak detection
—choosing materials
—plant load factor
—heat removal
—atomic projectiles
—Alpha particles
—Beta particles
—proton bombardment
—Gamma rays
—thermal insulations
—Shippingport plant

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***Contents***

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7. **Nuclear Fission**
8. **The Chain Reaction and Its Control**
9. **Nuclear Reactors**
10. **Reactor Materials**
11. **Reactor Systems and Auxiliaries**
12. **Reactor Loop Components**
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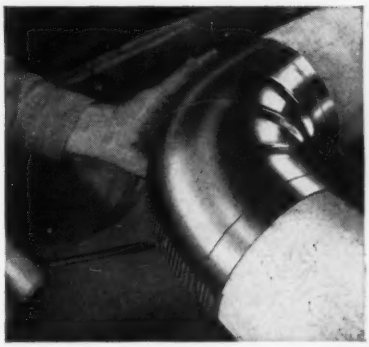
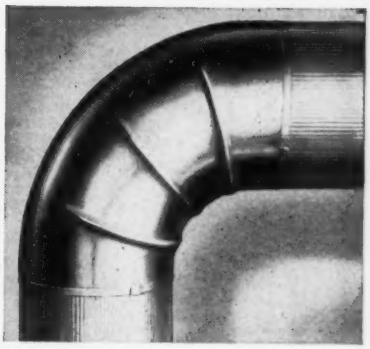
**9:00 A.M.** Workman places two halves of Ell-Jac over insulated elbow. Halves of Ell-Jac are held in place with wire while holes are drilled for sheet metal screws.



**9:04 A.M.** Screws are quickly inserted to hold Ell-Jac snugly and permanently in place. Childers Aluminum Ell-Jacs come in 23 standard sizes for both 90° and 45° long radius elbows.



**9:06 A.M.** Ell-Jac completely installed. When straight line aluminum weather-proof jacketing is added, lines have complete, maintenance-free protection for all costly insulation.

# How New Childers Ell-Jacs Save You Time and Money

**Revolutionary new Childers Ell-Jacs go on fast and easy . . . fit perfectly . . . cut installation costs . . . never need painting . . . and, used with Childers Jacketing, give your insulated lines that well-dressed look from end to end.**

**Now, aluminum elbows** are made in a wide range of sizes by America's leading manufacturer of aluminum jacketing. Childers Aluminum Ell-Jacs are available for quick, easy application to protect costly elbow insulation.

**Childers Ell-Jacs,** together with Childers Jacketing, enable you to install maintenance-free aluminum over every square foot of your valuable insulation. You protect *all* of your insulation investment at lowest cost. You get the bonus of a better looking plant and easier housekeeping.

**Leading power plant engineers** report that insulation on steam lines *lasts far longer* when protected with Childers Aluminum Jacketing. Childers Jacketing protects the insulation indefinitely against damage from workmen, equipment, and dripping fluids like oil and grease.

**You can reduce heat loss** by radiation, too, when you use Childers Jacketing on power plant lines and insulated equipment. This means increased plant efficiency and lower fuel costs.

**You end maintenance worries** by using Childers Aluminum Weather-proof Jacketing and Ell-Jacs. Aluminum *keeps* its new look; needs no expensive periodic painting.

**Positive weather-proofing,** too, is assured by exclusive Childers Lap-Seal (Patents Pending). Factory-attached moisture barrier prevents harm to the underneath side of the aluminum.

**You also get greater strength** and greater protection because Childers Jacketing is cross-crimped.

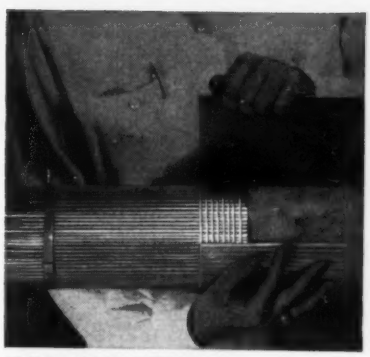
**First cost is less** for Childers Jacketing than for any other permanent-type weather-proofing—even less than some temporary coverings.

**It's easy to install** Childers Jacketing. All you need are pliers and screwdriver, plus inexpensive strapping. Two men can do the job. Jacketing can be removed to inspect lines, then reapplied without waste.

**Childers Engineering Representatives** in 27 cities provide technical information and assistance on the protection of insulated lines, elbows, towers, vessels and tanks. Only Childers has this nationwide service organization.

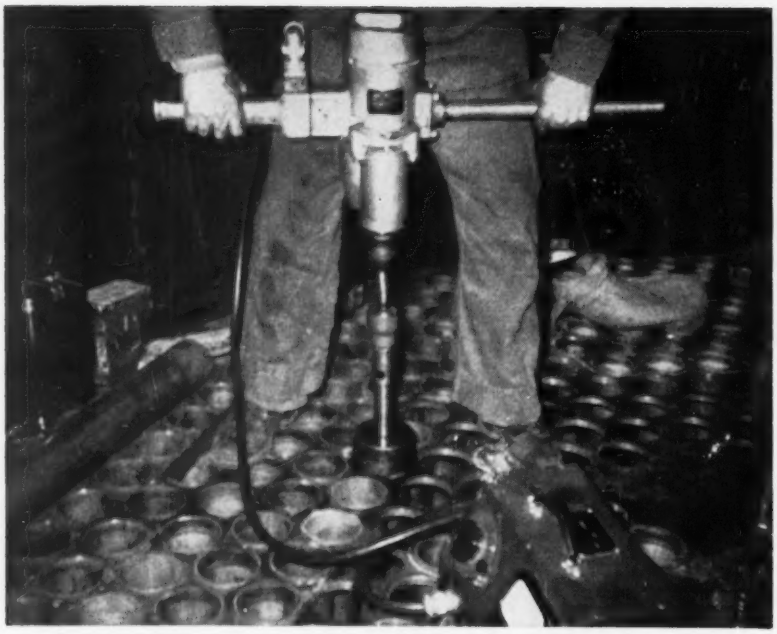
**For a free sample of** Childers Aluminum Weather-proof Jacketing, with engineering data on how to safeguard your insulation, write to Childers Manufacturing Company, Dept. P-15, P.O. Box 7467, Houston 8, Texas.

See Childers' ad in Sweet's, Chemical Engineering Catalog and Refinery Catalog.



**EXCLUSIVE LAP-SEAL,** available at no extra cost, is a series of 8 ribs rolled into the underlapping edge of the jacketing, providing an automatic measure of the 2" circumferential lap. Proper lap is assured without waste. Labor is saved. Where desired, a positive weather seal is easily made with Lap-Seal and a mastic.

**CHILDERS HEAVY WEIGHT** aluminum jacketing is recommended for extra protection of lines along walkways and other areas subject to physical abuse. Also recommended for protection of insulated towers, vessels and tanks. Comes in labor-saving 4' wide rolls.



# 850 tubes rolled in less than 5 hours!

**AIRETOOL Automatic Tube Expansion Control System simplifies and speeds accurate tube rolling!**

A large coppersmithing company* recently faced one of the biggest tube rolling and expanding jobs of its kind when they had to roll 850 4 in. OD x 13 gage copper tubes in a limited time. Using AIRETOOL'S Automatic Tube Expansion Control System, they rolled those tubes at a rate of one every twenty seconds . . . completed the job in *less than five hours!*

You too, can shorten tube rolling time immensely . . . eliminate costly over-rolling, over-expanding and distortion of tube sheets . . . with AIRETOOL'S Automatic Tube Expansion Control System. Ask for an ON-YOUR-JOB demonstration, today. *Name upon request

**SOLVE ALL YOUR TUBING PROBLEMS, FROM INSTALLATION TO REMOVAL, WITH AIRETOOL TUBE MAINTENANCE EQUIPMENT**

CONDENSER CLEANERS

Outside mounted . . . direct or gear driven. Powerful . . . fast . . . lightweight. Clean lightly scaled or completely plugged tubes to 1". Built-in flushing system cools drill, removes chips.

CONDENSER TUBE EXPANDERS

Parallel rolling . . . self-feeding . . . ball bearing thrust collar. Roll tight accurate tube joints to uniform expansion and tightness with maximum bonding.

TUBE CLEANERS

Powerful . . . fast cutting . . . quickly, completely remove hardest deposits. Air Driven motors in wide range of sizes and speeds.

*Write for illustrated literature, (Bulletin 60), showing AIRETOOL'S complete line of tube maintenance equipment.*

**AIRETOOL**
**MANUFACTURING COMPANY**
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BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.
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EUROPEAN PLANT: Vlaardingen, The Netherlands. CANADIAN PLANT: 37 Spalding Drive, Brantford, Ontario.

## My biggest boner

Biggest boner I ever pulled—and I've had my share—was not to check the blowdown valves before entering a boiler's steam drum. That did settle the old question though of how fast you can get through a boiler manhole. Incident happened in a shipyard during the war.

I worked with the ship's engineers cleaning up and ironing out bugs in engine rooms of an escort carrier. Ship had two boilers per engine room. Usually both boilers were secured before any work was done. But this time we had to clean tubes of one boiler while the second was steaming.

Our crew of operating engineers were an ex-policeman, an ex-farmer, an ex-truck driver, and ex-barber. Most of the men had little if any operating experience.

That evening I took my turn running the "rattler" through the tubes in the upper drum. As I crawled into the drum a fleeting thought went through my mind—I should check the blow-off valves. But to check them seemed like too much work.

I sat inside, dopey, dreaming of a blonde I had met. All at once I heard a rumble. It took a second or two for the rumble to penetrate my reverie. Then I turned around and saw steam coming up the tubes behind me. Looking me right in the face was the surfaceblow outlet.

Well, next thing I knew I was outside the drum on the grating. I never did know how I got out but the boys on the deck below said I was all hands and feet. Guess I flew through that manhole. I'll bet if I had missed the hole I'd have made a new one. But it was my fool luck that the surfaceblow valve was closed, or else I would have been scalded to death.

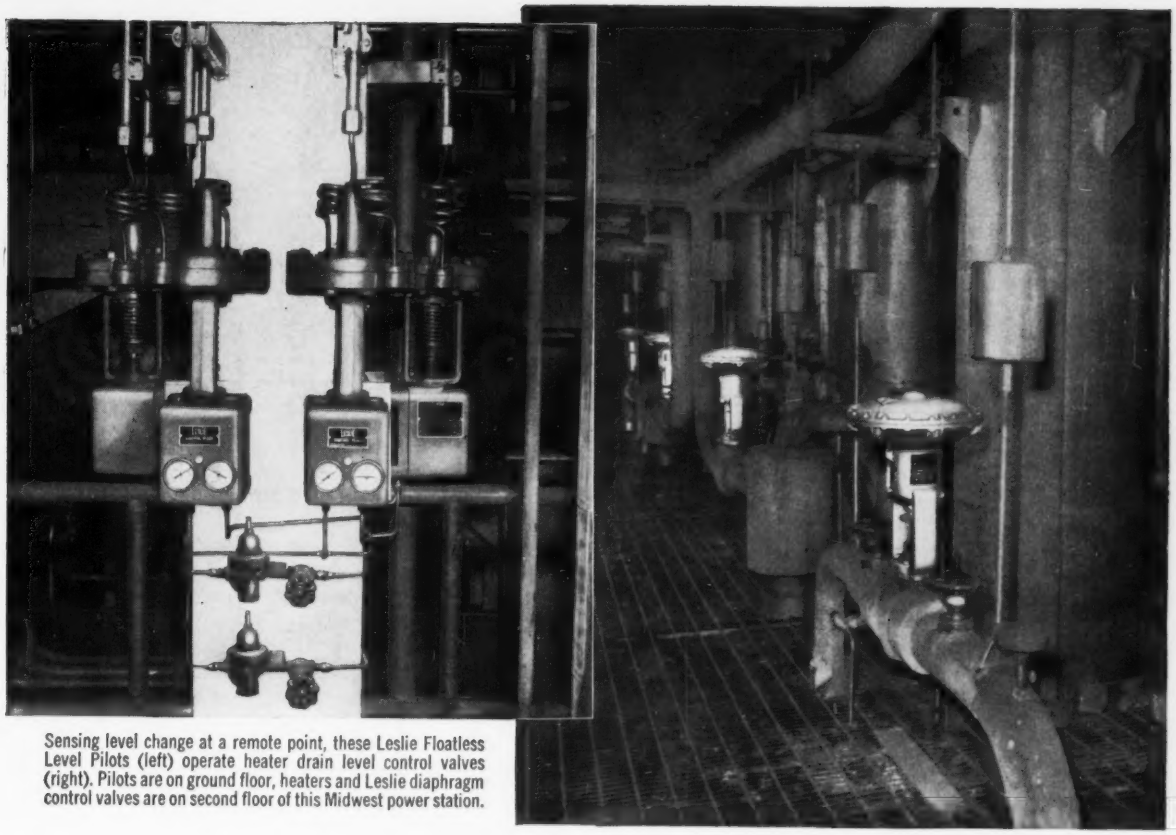
K M White, *Chamois, Mo.*

## REPORTS from the FIELD

*Begins on page 144*

### North German site chosen for atomic research center

Bonn—(McGraw-Hill World News)—The North German university town, Kiel, will probably become one of the most important atomic research centers of Europe. Two six-story institutes for applied and pure nuclear physics will be built on the university grounds where Professor Erich Bagge will establish departments for reactor technique,



Sensing level change at a remote point, these Leslie Floatless Level Pilots (left) operate heater drain level control valves (right). Pilots are on ground floor, heaters and Leslie diaphragm control valves are on second floor of this Midwest power station.

## differential pressure method offers

# STABLE, FASTER-SENSING LEVEL CONTROL

Because the Leslie Level Control Pilot uses the differential method for sensing changes in liquid level, it receives its impulse changes faster than any other type of level control. You can install it *anywhere* below liquid level, mounted on the valve, or at a point remote from vessel or valve. Used on either open or pressurized vessels, it controls the liquid level in such applications as condenser hotwells, deaerators, heater drains as shown above and storage tanks.

### *And It's Floatless, too!*

There are no floats, torque tubes, seals, stuffing boxes or thermal-hydraulic tubes which are affected by turbulence, wear or temperature changes. Installation is fast and uncomplicated. Simple spring adjustment changes set point. Maintenance free, rugged "high impact" design is unaffected by shock. The only *one* moving element is virtually frictionless . . . its total movement is only .006".

### *Responds Fast . . .*

A high air loading capacity in the Leslie Control Pilot means a fast response with a smooth, throttling action free from hunting or cycling.

### *More Information*

Ask your Leslie engineer to give you the complete story of the exclusive features that make Leslie Control Pilots ideal for level control problems. He's listed in your classified telephone directory under "valves" or "regulators".

*Send for the engineering data bulletin No. 5303.*

TRADE LESLIE MARK

## REGULATORS AND CONTROLLERS

LESLIE CO., 235 GRANT AVENUE, LYNDHURST, NEW JERSEY

606

| pumping something special? | check these special features available with Yeomans Vertical Wet Pit Centrifugal Pumps* |
|---|---|
| sand, glass particles and other abrasives | *Lubri-Vac*® reduces by 95% the failure of bearings due to scoring by abrasive particles. Lubri-Vac constantly flushes bearings with lubricant, keeps foreign matter away. (An exclusive Yeomans feature included on all heavy-duty pumps.) |
| ash, fly ash, cinders, bits of coal, corn foots and other solids contained in drainage | A cradle pump with protective sleeves to protect shaft. Special manganese steel parts. Yeomans pumps including these features will give long life under the most severe abrasive conditions. |
| potassium cyanide, sulphuric acid, jet fuel, melted naphthalene and other toxic or volatile liquids | Shaft seal is not under liquid pressure with Yeomans Vertical Wet Pit Pumps. This feature eliminates the leakage hazard which is present with horizontal pumps. |
| molten phosphorous, acetic acid, hydrochloric acid, black liquor and other corrosive liquids | Whatever the corrosive and/or abrasive liquid to be pumped—Yeomans has special ferrous and non-ferrous alloy parts to handle it. |

*Vertical Wet Pit Centrifugal Pumps save floor space, require no priming —no costly liquid leaks as stuffing boxes are not under liquid pressure. Capacity range from 5 g.p.m. to 10,000 g.p.m.

YEOMANS

2002-2 NORTH RUBY STREET, MELROSE PARK, ILLINOIS

☐ Please send me the catalog, "Yeomans Heavy-Duty Wet Pit Pumps."

☐ I wish to know how I may see Yeomans' 15 minute film on Wet Pit Pumps.

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Company_____

Street_____

City_____ Zone_____ State_____


# REPORTS from the FIELD

Begins on page 144

radiation research and nuclear fusion.

The 30 existing reactor types will be tested here with regard to safety, profitability and utilization. This field has not been investigated in Europe so far.

The Kiel Institute will cooperate closely with the atomic reactor planned in Geesthacht near Hamburg and will also exchange information with engineering schools in Kiel, Flensburg, and Luebeck, all of which maintain isotope laboratories.

## Calendar of Events

**Aug 12-15—American Society of Mechanical Engineers and American Institute of Chemical Engineers,** First National Conference on Heat Transfer. Pennsylvania State University, University Park, Pa. Details from ASME, 29 W 39th St, New York 18, N.Y.

**Aug 28-30 — Instrument Society of America,** International Symposium on Gas Chromotography. Kellog Center for Continuing Education, East Lansing, Mich. Details from ISE, 313 6th Ave, Pittsburgh 22, Pa.

**Sept 8-13—Investment Casting Institute,** 2nd Annual Course on Investment Castings. Massachusetts Institute of Technology, Cambridge, Mass. Details from ICI, 27 E Monroe St, Chicago 3, Ill.

**Sept 9-13 — Instrument Society of America,** 12th Annual Instrument-Automation Conference and Exhibit. Cleveland Auditorium, Cleveland, Ohio. Details from ISA, 313 6th Ave, Pittsburgh 22, Pa.

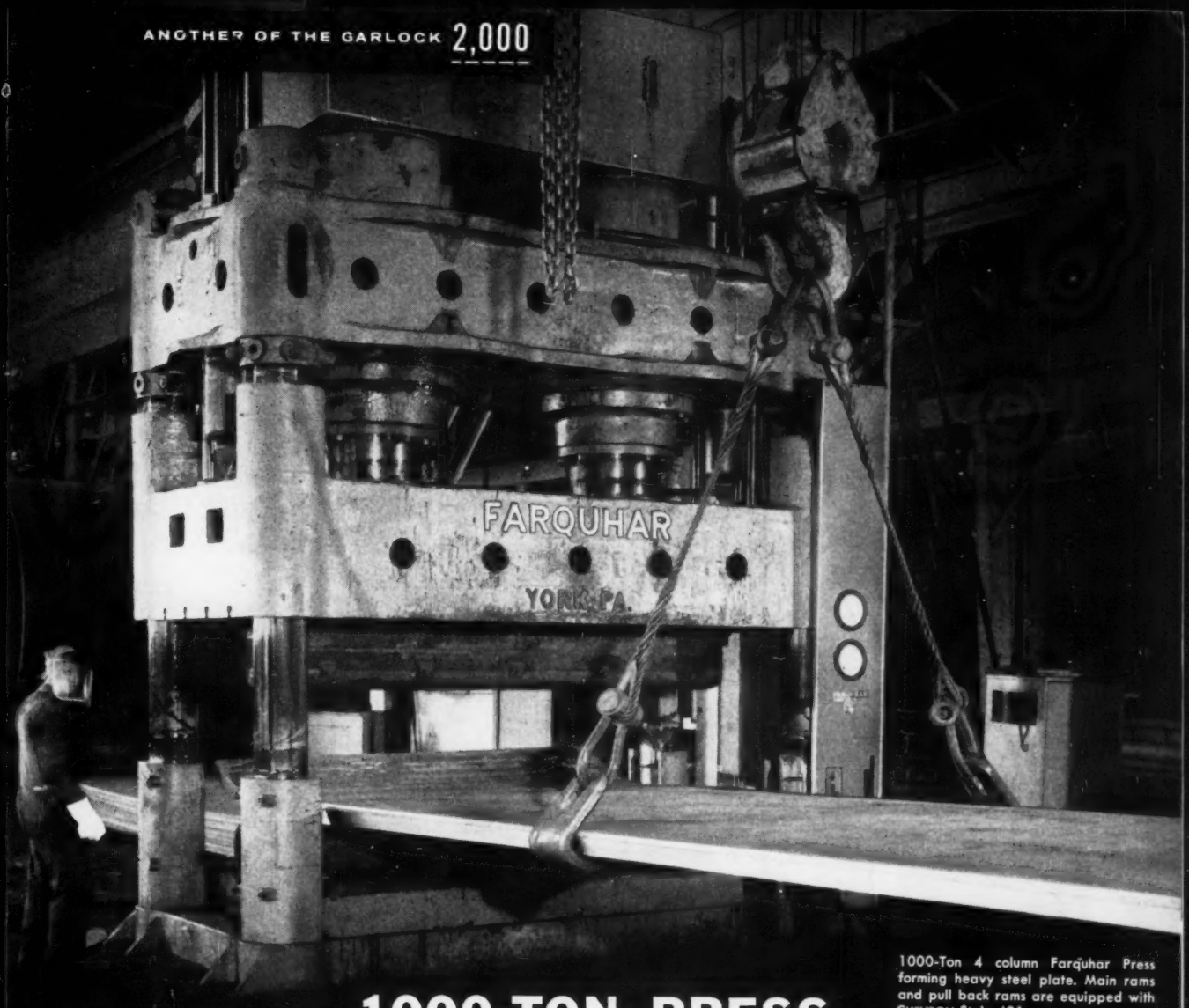
**Oct 1-4—National Association of Corrosion Engineers,** exhibitions and meetings of North Central Region and South Central Region. Exhibition and Technical sessions, North Central Region: Sherman Hotel, Chicago; South Central Region: City Auditorium, Oklahoma City, Oklahoma. Details from NACE, 1061 M&M Bldg, Houston 2, Texas.

**Oct 7-9—National Electronics Conference.** Hotel Sherman, Chicago. Details from NEC, 84 E Randolph St, Chicago 1, Ill.

**Oct 6-8—Fluid Controls Institute.** Westchester Country Club, Rye, N.Y. Details from Air Conditioning and Refrigeration Institute, 1346 Connecticut Ave, N.W. Washington 6, D.C.

**Oct 7-9—American Society of Lubrication Engineers and American Society of Mechanical Engineers,** 4th Lubrication Conference. Royal York Hotel, Toron-

ANOTHER OF THE GARLOCK 2,000



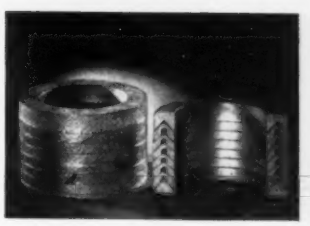

1000-Ton 4 column Farquhar Press forming heavy steel plate. Main rams and pull back rams are equipped with CHEVRON Style 431.

# 1000-TON PRESS
## attests "stamina" of Garlock CHEVRON* packing

The shock absorbed during operation by this Farquhar 1000-Ton, 4 column press makes necessary the use of a packing that will automatically compensate for sudden changes in pressure. In addition, the packing must be extremely durable to minimize downtime.

That's why engineers at A. B. Farquhar Division of The Oliver Corporation, York, Pa., specify Garlock CHEVRON exclusively for the main rams and pull back rams of this press. CHEVRON's unique construction permits free operation of rams at all pressures. It automatically tightens or eases-off as pressures increase or decrease . . . prevents leakage without hampering operation.

CHEVRON is another vital part of "the Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every conceivable need—the only complete line. That's why you get unbiased recommendations from your Garlock representative. Call him today or write for CHEVRON Folder AD-115.



Style 431 CHEVRON assures low friction, positive seal, lasts longer than ordinary V-type packing, and works efficiently in shallow stuffing boxes.

**THE GARLOCK PACKING COMPANY, Palmyra, N. Y.**

**For Prompt Service,** contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

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GARLOCK

*Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products*

# Stop Corrosion

in boilers, steam and return lines . . .

**with this Stickle deaerating feed water heater**

SAVES STEAM
Vent Condenser releases only air and contaminated gases to atmosphere
NO CONTAMINATION
Counterflow of steam and water prevents reabsorption of oxygen
SELF-CLEANING
There is no need for removable baffles or trays

Stickle Baffle Spray Type Deaerating Feed Water Heaters stop corrosion by removing destructive oxygen and carbon dioxide from boiler feed water . . . reduce fuel costs and boiler strain. Vertical and horizontal models. Capacity range: 3,000 to 300,000 pounds per hour. The latest development in more than 50 years of building feed water heaters.

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S-217 . . . Baffle Spray Type Deaerating Feed Water Heaters
117 . . . Open Coil Feed Water Heaters

**STICKLE STEAM SPECIALTIES CO.**
2265 Valley Ave. • Indianapolis 16, Ind.

**Stickle Equipment**
Cuts the cost of steam


# REPORTS from the FIELD

*Begins on page 144*

to, Ontario. Details from ASLE-ASME Lubrication Conference, 150 E 42nd St, New York 17, N.Y.

**Oct 9-11 — Committee on Vacuum Techniques,** 4th Annual Symposium on High Vacuum Technology. Hotel Somerset, Boston, Mass. Details from CVT, Box 1282, Boston 9, Mass.

**Oct 10-11—National Noise Abatement Symposium.** Sherman Hotel, Chicago, Ill. Details from Illinois Institute of Technology, 35 W 33rd St, Technology Center, Chicago 16, Ill.

**Oct 14-16—Industrial Sanitation Management Association,** 2nd Annual Sanitation Maintenance Show and Conference. Navy Pier, Chicago, Ill. Details: International Sanitation Maintenance Show and Conference, 19 W 44th St, New York, N. Y.

**Oct 14-18 — International Industrial Development Conference,** co-sponsors: Time-Life International and Stanford Research Institute. Fairmont Hotel, San Francisco, Calif. Details from Stanford Research Institute, Menlo Park, Calif.

**Oct 15-16—Corrosion Convention and Exhibition.** Sponsored by *Corrosion Technology* magazine. Central Hall, Westminster, London, England. Details from *Corrosion Technology*, Stratford House, Eden St, London N.W. 1, England.

**Oct 21-23—American Society of Mechanical Engineers,** conference on new developments in the field of power. Americus Hotel, Allentown, Pa. Details from ASME, 29 W 39th St, New York 18, N.Y.

**Oct 22-24—National Association of Corrosion Engineers,** 7th Annual Western Regional Conference. San Diego, Calif. Details: NACE, 1061 M&M Bldg, Houston, Texas.

**Oct 24-25—Engineers' Joint Council and Engineers' Council for Professional Development,** Engineers' General Assembly. Statler Hotel, New York. Details from Engineers' Joint Council, 29 W 39th St, New York 18, N.Y.

**Nov 2-8—American Society for Metals,** 2nd World Metallurgical Congress. Chicago, Ill. Details: Seward Covert & Associates, 530 Leader Bldg, Cleveland 14, Ohio.

**Nov 18-21—Air Conditioning and Refrigeration Institute,** 10th Exposition of Air Conditioning and Refrigeration Industry. International Amphitheatre, Chicago, Ill. Details from the Institute, 1346 Connecticut Ave, NW, Washington 6, D.C.

## Titanium-melting furnace sets new pace for industry

► "THE TOUGHEST METALS KNOWN TO MAN" moved a step nearer industry-


# Here's the Great Combination for those...

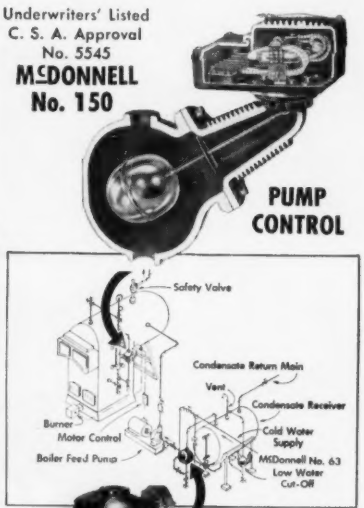
## Medium Pressure Boilers

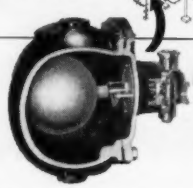
***(up to 150 lbs. psi.)***

The No. 150 controls the boiler feed pump the one right way—directly from the boiler water level. Holds boiler level within close limits to assure maximum steaming efficiency and fuel economy. Has extra switch which provides circuits for cutting off burner and sounding alarm in case of low water emergency. It's the most widely-used, time-proved control of its kind.

Underwriters' Listed
C. S. A. Approval
No. 5545

**McDONNELL No. 150 PUMP CONTROL**



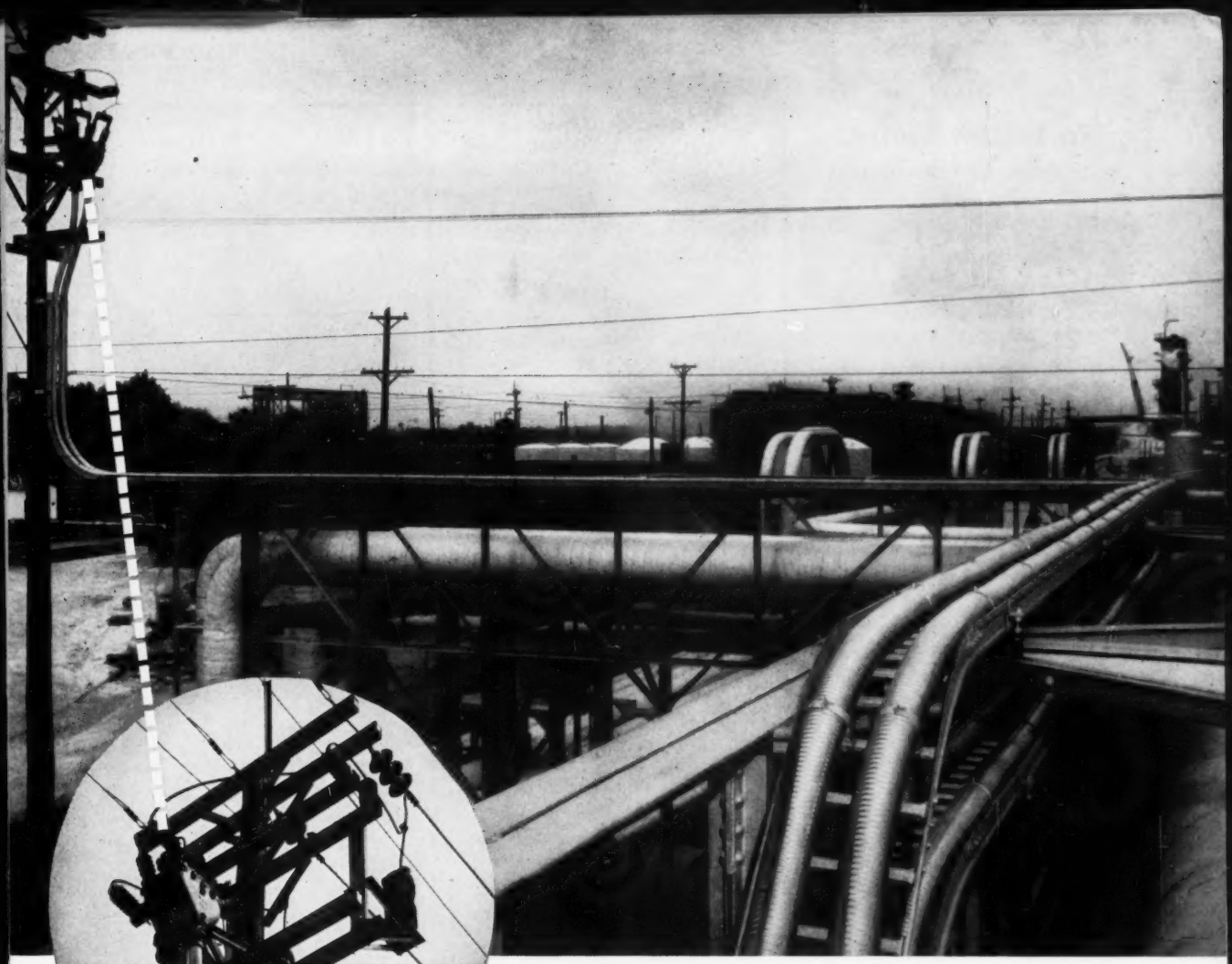
**McDONNELL No. 27T MAKE-UP FEEDER**

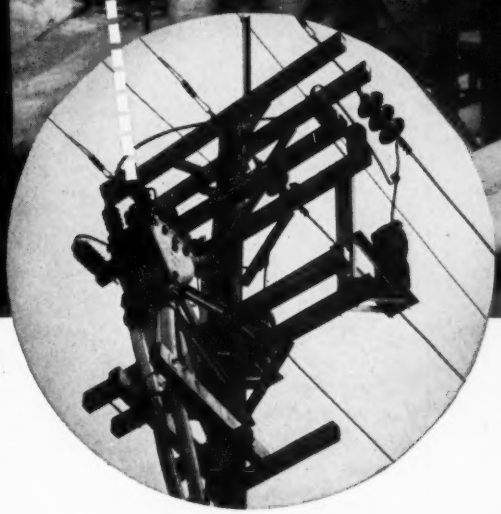
Adds water to condensate receiving tank whenever necessary to make up for any deficiency in returns. Large feeding capacity meets any sudden boiler demand for water. Needle and seat are stainless steel assuring powerful drip-tight closure. For tank pressures to 35 psi., supply pressures to 100 lbs.

***Write for simple installation and wiring diagrams***

**McDONNELL & MILLER, INC.**
**3506 N. Spaulding Ave., Chicago 18, Ill.**

*Doing One Thing Well*
**McDONNELL**
Boiler Water Level Control and Safety Devices





# new 15kv Loxarmor* circuits eliminate conduit, allow simple terminations

Stainless steel Loxarmor cable was recently chosen by the Petro-Tex Chemical Corporation, jointly owned by Tennessee Gas Transmission Co. and Food Machinery and Chemical Corp., for main feeder circuits in their Houston, Texas plant.

Heart of this system is Okolite insulation applied by Okonite's strip-insulating method. The advantages inherent in the Loxarmor construction add considerably to the basic advantages of the Okolite insulation.

***Advantages of Loxarmor construction:***

**. . . stainless steel armor provides the ultimate resistance to corrosive atmospheres prevalent in petrochemical plants.**

**. . . reduces installation and maintenance costs because of flexibility and the elimination of rigid conduit. Open type construction permits quick, simple inspection of your electrical system.**

**. . . completely salvageable—can be re-used at will or can be easily re-routed.**

**. . . standard fittings permit relatively simple terminating procedures.**

Petro-Tex Chemical Corporation's use of this construction typifies the modern trend to Loxarmor. Where the maximum security of a rigid conduit is not necessary, Loxarmor is a highly acceptable alternate.

Bulletin PW-1090 provides a thorough description of Loxarmor, providing engineering information, splicing and terminating drawings and instructions, and a discussion of the various components. Loxarmor power and control cables are available with any of Okonite's strip-insulated and extruded rubber insulations or with varnished cambric and plastic dielectrics. Write for it today to The Okonite Company, Passaic, N. J.

***Okonite's trade name for interlocked S-shaped armor—available in stainless or galvanized steel, aluminum or bronze. Protective coverings can be applied over the armor for special corrosion and chemical resistance.**

4710

***where there's electrical power . . . there's*** **OKONITE CABLE**

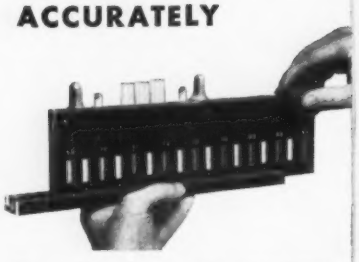
To Inhibit Scaling and Corrosion

TAYLOR COMPARATORS

HELP YOU ADJUST

pH, PHOSPHATE LEVELS

QUICKLY, ACCURATELY



By making fast, on-the-spot determinations for pH, phosphate, nitrate or silica with handy, portable Taylor Comparators, you can easily maintain proper control of boiler, condenser or cooling tower operations. In a matter of minutes you get accurate, dependable data from easy, colorimetric tests. Only three simple steps . . . fill three tubes with sample, add reagent to center tube and read result direct from slide after matching colors. Complete instructions, all necessary accessories and reagents included in every set.

WATER HARDNESS may be determined easily, yet with accuracy of an alkalinity titration, with the Taylor Total Hardness Set.

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Be sure to use only Taylor reagents and accessories with Taylor Comparators to assure accurate results. All Taylor liquid color standards carry an unlimited guarantee against fading.

**SEE YOUR DEALER** for Taylor sets or immediate replacement of supplies. Write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO. 4, MD.

# REPORTS from the FIELD

Begins on page 144

wide production with a recent announcement by three companies that a new furnace, pioneered in titanium melting and described as a "major metallurgical breakthrough," is being made available in the metals industry.

The unit, is called a consummable electrode vacuum remelting furnace. It melts titanium, zirconium, high alloy steels, or other ferrous or non-ferrous alloys, which are remarkably free of impurities and possess improved properties.

Such high-performance metals are used in building jet aircraft and engines, missiles and atomic reactors.

One official said the precision low-cost melting technique was in great part responsible for advancing titanium to a tonnage metal at constantly lower price levels.

The announcement came from Titanium Metals Corp of America, jointly owned by Allegheny Ludlum and National Lead Co, Allegheny Ludlum Steel Corp, and the Lectromelt Furnace Div of McGraw-Edison, which will manufacture and sell the furnace.

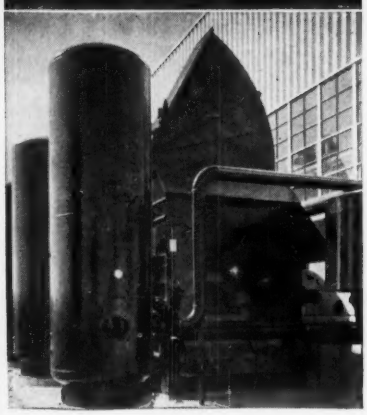
## 10-kw steam turbine generator goes on view at Smithsonian

► ASSIGNED FOR PERMANENT DISPLAY at the new hall of power machinery of the Smithsonian Institution is this pioneer geared steam turbine generator, the very first one used in the U.S. for the production of electricity on a commercial scale.

It was built by the De Laval Company in Sweden. This 10-kw unit, and the electric light it produced, were exhibited at the World's Fair in 1893 as engineering marvels of the time. Three years later, the New York Edison Co purchased larger models of the same type for their New York electric power producing plant.

Shown viewing the unit, left to right, are C R Waller, consultant engineer of De Laval Steam Turbine Co, of Trenton, N.J., who joined the De Laval organiza-

HOW YOU SAVE . . .



. . . getting drier Compressed Air

Direct saving in the cost of cooling water saves the price of the Niagara Aero After Cooler (for compressed air or gas) in less than two years.

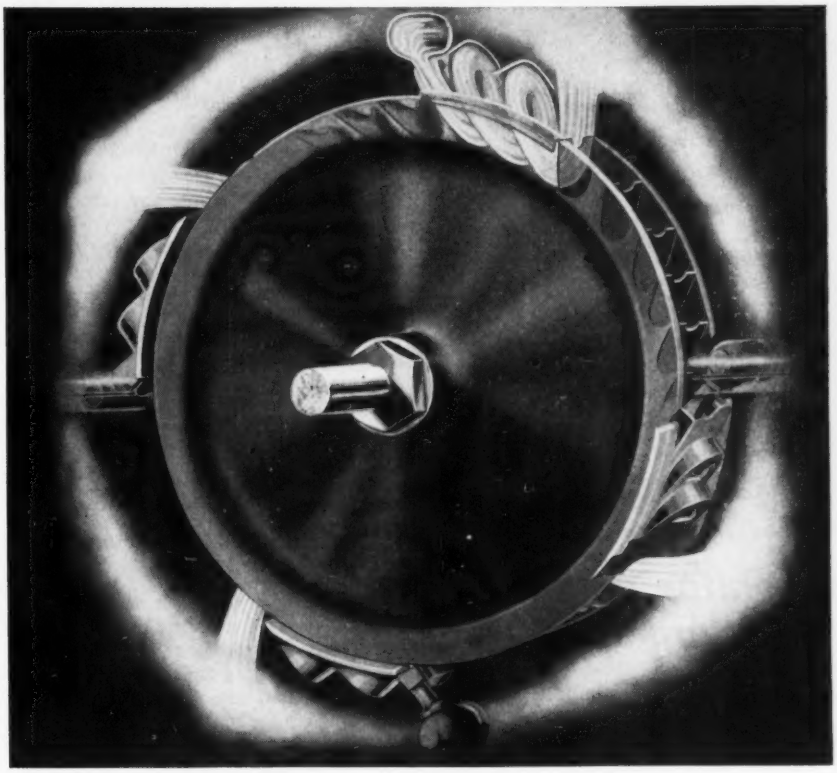
Extra, for no cost, the drier air gives you a better operation and lower costs in the use of all air-operated tools and machines, paint spraying, sand blasting or moisture-free air cleaning. Water saving also means less expense for piping, pumping, water treatment and water disposal, or you get the use of water elsewhere in your plant where it may be badly needed.

Niagara Aero After Cooler assures all these benefits because it cools compressed air or gas below the temperature of the surrounding atmosphere; there can be no further condensation in your air lines. It condenses the moisture by passing the air thru a coil on the surface of which water is evaporated, transferring the heat to the atmosphere. It is installed outdoors, protected from freezing in winter by the Niagara Balanced Wet Bulb Control.

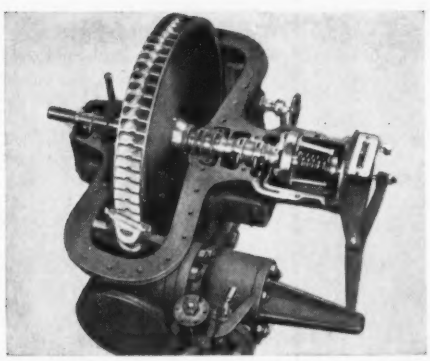
*Write for Bulletin No. 130.*
*Address Dept.* **P-8**

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N.Y.
*District Engineers*
*in Principal Cities of U. S. and Canada*

# TURBINE BLADES CAN'T FOUL!



The Terry solid-wheel turbine is of the impulse, helical flow type. The steam issues from an expanding nozzle at high velocity and enters the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is returned to the wheel several times until practically all of the energy has been utilized. This principle makes possible the efficient use of steam in a single-piece, almost indestructible wheel.



## Terry solid-wheel design permits large clearances

In the Terry solid-wheel turbine, the steam enters the buckets in a direction at right angles to the shaft, as shown above. This design eliminates the need for close clearances and provides positive blade protection.

The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, projecting rims on each side of the buckets prevent damage to the blades even though external thrust should move the wheel.

This is only one of the many advantages of Terry solid-wheel turbines. Write for complete details. Ask for a copy of bulletin S-116.

TERRY

TT-1206

**THE TERRY STEAM TURBINE CO.**
TERRY SQUARE, HARTFORD 1, CONN.

## *Panalarm Annunciator pinpoints process "off-normals"*

In the process industries and among users of automatic machinery, trouble is minimized when it's caught early. That's the purpose of the Panalarm Annunciator System—a continuous monitor of your process.

One typical adaptation of the modular Panalarm system is engineered to differentiate between the first "off-normal" and subsequent "off-normals" caused by the first. This feature allows instantaneous recognition of the prime source of trouble in a "chain reaction."

Another adaptation is designed specifically for motor start-up and shut-down. It has also been successfully adapted for supervisory control, pump control and programming.

Your Panalarm sales engineer will be happy to make a survey of your requirements to determine whether a Panalarm system can aid productivity and safety in your process. For electrical and mechanical data on standard systems, request Catalog 100B on your letterhead.

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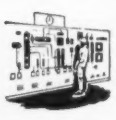
**Engineered Information Systems for Industry**


Graphic Panels, Control Centers

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# REPORTS from the FIELD

*Begins on page 144*

tion when the unit was in service, James P Stewart, president of De Laval, Robert P Multhaulf, curator, Department of Engineering of Smithsonian Institution, and Hans G Bauer, vice president of De Laval.

### A&F Power continued

Tariff Reform Bill that will hit hard at the A & F exchequer. A clause has been added that calls for all power companies to remit profits via the free exchange market. Right now the free exchange is around 70 cruzieros to the dollar. The power companies had been getting a special rate—paying only 44 cruzieros to the dollar.

Company officials are waiting anxiously to see if the bill goes through. The question of a Tariff Reform came up previously in the House of Deputies but was vetoed by President Juscelino Kubitschek and failed to pass. Now it's back; this time with a solid group of backers. A worrisome year for A&F Power.

### Ionization chamber monitors research reactors

► To FULFILL A NEED for a simpler and more reliable device for monitoring the power of nuclear research reactors, Atomics International, a division of North American Aviation, Inc, has developed an uncompensated ionization chamber, the company announced recently.

In addition to being used on research reactors operated by Atomics International, the ionization chambers were installed on the industrial research reactor the company completed last year for the Armour Research Foundation.

**"Things are getting dull around here, Frank . . . let's start a rumor."**

# don't waste steam

**Nicholson steam traps** have a powerful, intermittent valve action which closes the valve *completely*. Hardened stainless steel valve and seat are lapped and mated—there's no steam waste, no dribbling. And that's not all. With just one thermostatically-operated moving part, there's nothing to get out of order, nothing to go wrong. Nicholson means continuous and low-cost operation of your steam-using equipment . . . no downtime from trap failure.

- **high air-venting capacity . . . for faster warmup of equipment.**
- **small and lightweight . . . easy to pipe and support.**
- **each unit steam-tested before shipment.**

So, to get a trap that avoids waste, saves money, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA. *Sales and Engineering offices in 98 principal cities.*

*Write for Bulletin 1055*

**NICHOLSON**
*of Wilkes-Barre*

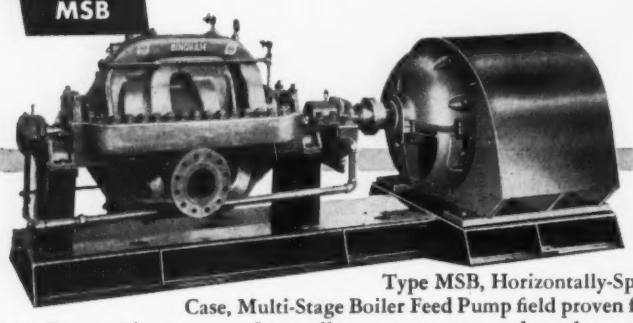
Specify

Bingham

"DOUBLE VOLUTE"
BOILER FEED PUMPS

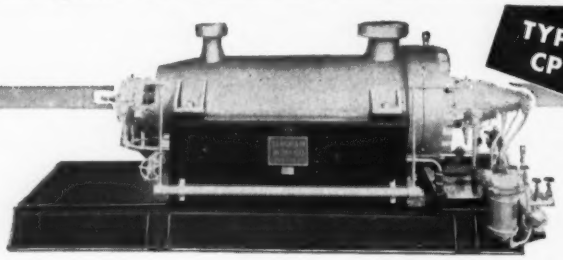
for the ultimate in dependability
IN HIGH PRESSURE SERVICE

TYPE MSB



Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham
SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
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Los Angeles, Calif. — Tulsa, Okla.
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Vancouver, B. C., Canada

## More TECHNICAL BRIEFS

Begins on page 146

ondary consideration, while qualities such as absence of vibration, absence of wear particles, absence of oil drip, small power consumption and high stiffness are important. In such cases, lubrication with a gas presents definite advantages.

The author describes experiments on gas-lubricated journal bearings in which all the main variables — gap, radius, length, speed, ambient pressure, ambient gas and load—are varied, and notes the effect of each upon deflection and attitude angle. He makes no quantitative comparison with available theory, as agreement with noncompressible theory is, in general, not good.

The paper concerns itself only with gas bearings where the load capacity comes from the hydrodynamic phenomenon, and not hydrostatic gas bearings, where at least part of the load capacity comes from gas supplied to the bearing, under pressure, from an external source. *ASME paper, No. 56-LUB-8.*

**Testing dynamically loaded bearings: 1—a short history of bearing test machines.** *By M D Hersey and R B Snapp, U.S. Naval Engineering Experiment Station.*

Bearing test machines with dynamic loading or nonuniform motion are described in this paper and classified according to the type of loading employed. Over thirty such machines have been disclosed in the published literature, including both endurance machines and research machines for investigating oil-film performance.

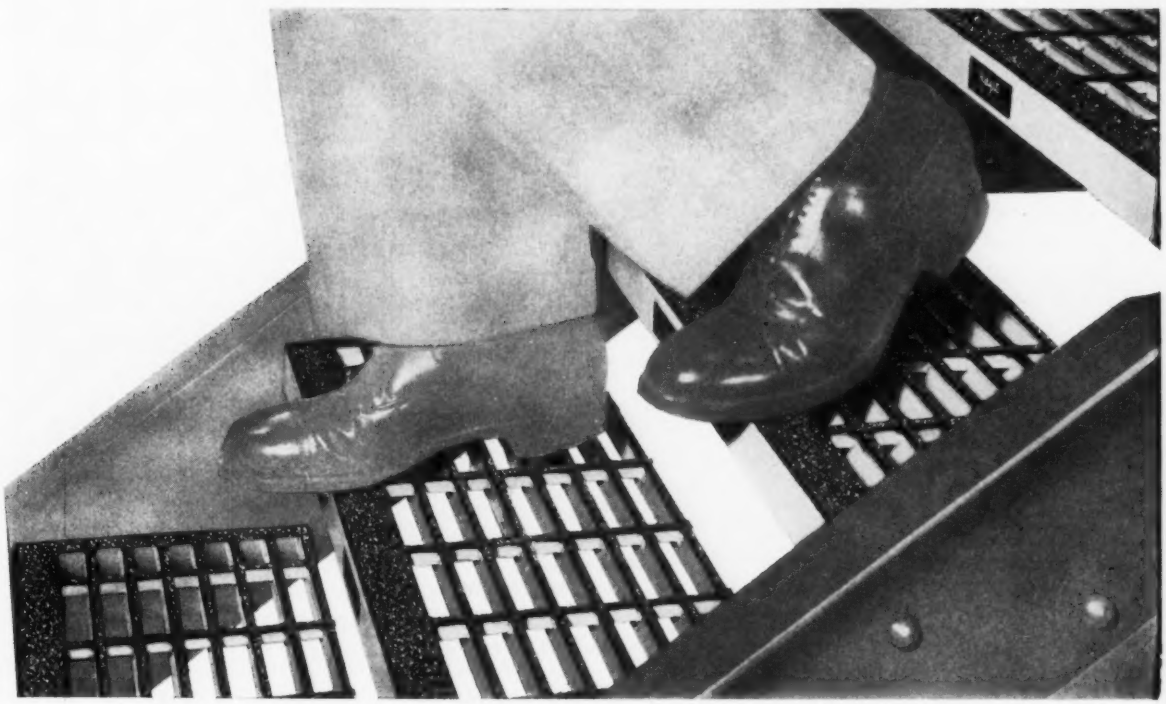
The authors have endeavored to find answers to six questions concerning each machine: (1) its loading mechanism (2) test bearing details (3) range of variables (4) performance criteria (5) characteristic limitations or advantages (6) extent of use. *ASME paper, No. 56-LUB-3.*

**Testing dynamically loaded bearings: 2—a diesel engine bearing test machine.** *By R B Snapp and M D Hersey, U.S. Naval Engineering Experiment Station.*

This paper describes an engine-bearing test machine consisting of a motor-driven modification of a commercially available diesel engine. The machine combines the advantages of engine operation with those of a standardized test machine. It was developed primarily for endurance testing of engine-bearing materials and design. A rating sys-

Directions for ordering papers on p 222

# *Eliminate slipping accidents!*



# Relgrit® Abrasive Embedded Grating Treads

Industrial plants throughout the country have found that Relgrit has practically eliminated slipping accidents wherever used.

Relgrit treads are made with an aluminum oxide abrasive, embedded in a "V" groove at the top of the grating bars and nosing. This forms a skid-proof surface that is virtually immune to wear; providing *permanent* protection from slippery surfaces due to water, mud, oil, grease, acids and chemicals. Relgrit is also made for platforms and all other grating areas.

Write for free sample and literature

*You can't slip on Relgrit**

*Patent applied for

## Reliance Steel Products Company

**P. O. BOX 510-J, McKeesport (Pittsburgh District), Pa.**

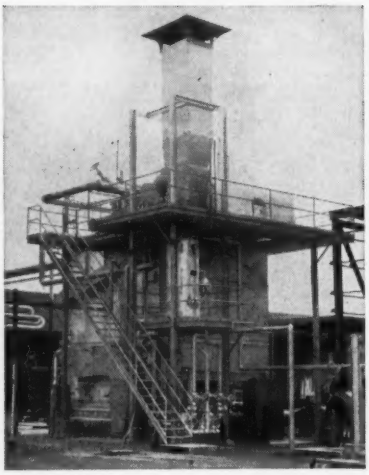
*Relgrit Abrasive Gratings and Treads • Lightweight Bridge Flooring*
*Steel, Stainless and Aluminum Grating • Steel Mill Equipment*

# BROS BOILER-STOKERS SUPPLY 11 ACRES OF HEAT AND POWER AT WORLD'S LARGEST NUT PROCESSING PLANT

**DIAMOND WALNUT GROWERS, INC.** wanted complete efficiency in its huge, new nut processing plant. And they certainly are getting it. Take steam, for example:

This 11 acre plant at Stockton, California, uses steam for heat, steam for power and steam for its ammonia absorption refrigeration system of air conditioning.

Added to the plant's operating efficiency, walnut shells serve as an auxiliary fuel to gas; thus, a disposal problem is eliminated and a very sizable saving in annual fuel cost is made.



Meeting the 35,000 lbs. steam load at 250 psig is a Bros A-3 Boiler fired by 2 Bros Superspred Stokers. The A-3 design offers effective heating surface which generates steam quickly and responds fast to load changes . . . and also provides the minimum of furnace maintenance.

Special features of the Superspred Stokers well serve the high operating efficiencies and dependable service expected at this new plant . . . as they are serving boiler plants throughout American industry.

BROS Packaged Boilers are providing steam for heat and process applications throughout industry; capacities range from 8,500 to 50,000 lbs. of steam per hour at standard design pressures of 250 psig. Special units for higher pressures are available.

Let Bros blueprint your success with steam; the skill of 75 years in engineering, manufacturing and installation of steam generating equipment is immediately available to you through our national sales representatives.

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**NATIONAL REPRESENTATIVES**

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DALLAS ..... *Mechanical Specialty Company*
DENVER ..... *Conwell-Lucas*
DETROIT ..... *Wayne Boiler & Equipment Co.*
DULUTH ..... *Williams-Swanson Company*
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1057 TENTH AVE. S. E. • MINNEAPOLIS 14, MINN.


## More TECHNICAL BRIEFS

*Begins on page 146*

tem is described for evaluating the extent of various kinds of failure elements so bearings may be compared without testing them to destruction. Test results and the use of an oil-film-thickness indicator are also described. *ASME paper, No. 56-LUB-4.*

**Surface roughness — a criterion for minimum hydrodynamic oil-film thickness of short journal bearings.** *By L F Kreisle, University of Texas.*

The minimum hydrodynamic oil-film thickness of a short journal bearing is defined as that value of the minimum oil-film thickness at which marginal procedures initially are substituted for hydrodynamic-film lubrication. This appears to occur when the minimum oil-film thickness equals the sum of the predominant-peak surface roughnesses of the bearing and journal, measured in the circumferential direction after run-in of bearing and journal. *ASME paper, No. 56-LUB-5.*

## Economics

**Economics of power reactor systems—sodium-graphite reactor.** *By C Starr, North American Aviation, Inc.*

At present the sodium-graphite reactor system provides a heat transfer temperature of 925 F with a projected temperature of 1200 F. The high operating temperatures and correspondingly high thermal efficiencies permit good steam conditions in the power conversion equipment. The engineering development of the sodium-graphite reactor and its heat extraction system may eventually permit producing steam temperatures limited only by turbine performance.

The capital charges for constructing (in the United States) a 75,000-kw plant have been estimated at $340 per installed kilowatt. Using 15% annual charges against the capital investment and assuming an 80% load factor, capital charges run 7.3 mills per kwhr. Fuel costs are estimated at 2.2 mills and fixed operating and maintenance charges at 2.0 mills per kwhr. The total combined cost of power from this plant is estimated at 11.5 mills per kwhr. As a comparison, the average total cost for a similar size conventional plant is 6 to 8 mills per kwhr.

Doubling the size of the plant to 150,000 kw reduces the power cost to an estimated 9.4 mills per kwhr. *AIF paper, no number.*

(*Continued on page* 222)

*Directions for ordering papers on p 222*

*Photo courtesy Public Service Co. of Oklahoma*

## He's Using an "Idea Amplifier" to solve a cost-cutting problem

**This Load Dispatcher's aim** at the moment is to coordinate regulation of hydro and steam generation. On paper at least, this coordination contributes to lowest-cost operation, but in actual practice, its execution involves numerous factors —many of them variables, and far too complex to be calculated manually in a hurry.

So the Dispatcher turns to electronics for amplification and execution of his idea. He uses the console in front of him to convert it to an electrical equivalent which is instantly calculated and telemetered in the form of control pulses to any given number of turbine governor motors simultaneously . . . and it's all done with cost-cutting accuracy beyond the ability of even the best manual operation.

The "amplifier" in this case is an Area Load Control console—a device with computing circuits that functions as the brain of each Leeds & Northrup Area Load Control system. Already, these custom-engineered systems are installed on utility networks accounting for nearly a *third* of American generation.

Operating flexibility of Area Load Control is one reason for this preference. For when day-to-day operating conditions change (due to wet coal, loss of a cooling fan, unscheduled maintenance, etc.) Area Load Control provides the Load Dispatcher with the necessary flexibility to meet these problems as they arise.

Next time you have an opportunity, talk with your power neighbors who use Area Control—get the benefit of their thinking plus the ideas of your own operating staff. It's a method for turning in cost-cutting recommendations that work.

# LOCKETT FUEL OIL PUMPING AND HEATING SETS

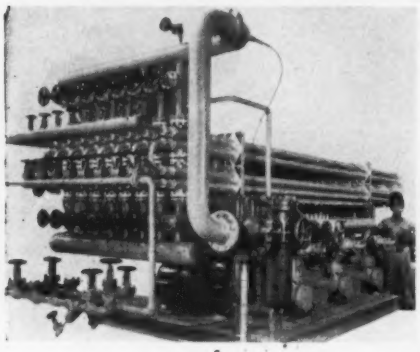

Photo shows one of two, High-Pressure (1000 PSIG) Units being furnished for a Public Utility in the Southwest . . . 3 electrically-driven screw pumps and multiple arrangement of Griscom-Russell Twin G-Fin Heaters handle 230 GPM of heavy fuel oil. Equipped with: Strainers, Temperature and Pressure Controls.

*Built To Engineers Specifications*

For more than a half-century Lockett has been supplying standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Various types of Pumps are available: Turbine or Motor-Driven Rotary Pumps, Electric-driven Rotary Pumps, and Duplex Steam Pumps, in any combination. Units can be furnished for any capacity or pressure desired; complete with Strainers, Pressure and Temperature Controls, and Instruments. Engineered to your requirements. Completely assembled and shop-tested. Inquiries are invited. *Descriptive Bulletins* sent on request.

**A. M. LOCKETT & COMPANY, LTD.**

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## More TECHNICAL BRIEFS

*Begins on page 146*

**Determination of steam costs.** *By C H Marks, Bituminous Coal Institute.*

In our modern economy, accurate production costs per manufactured unit are essential to permit profitable pricing of the product. As boiler and power departments of a manufacturing plant contribute materially to the cost of the final product, their costs must be accurately determined. An appropriate charge can then be made against the production items, and a basis provided for determining the economies of physical plant and operational improvements.

Accurate instrumentation and record compilation are necessary. Data must be kept on steam production, steam distribution, power production, maintenance costs, fixed costs, etc.

This paper deals specifically with the cost of steam produced in the boilerhouse. The method of distributing these costs to the various process and power departments of the manufacturing plant has recently been described by H P Kallen at the American Power Conference (Power, July 1957, p81). *NAPE paper, no number.* (Request copies from the author at Bituminous Coal Institute, Southern Building, 15th & H Sts, N.W., Washington 5, D. C.)

**TO OBTAIN COMPLETE TEXT**

*Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not* POWER.

*American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.*

*American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.*

*American Power Conference, 18th annual meeting. Identified by initials APC and obtainable through purchase from director, APC, Illinois Institute of Technology, Chicago 16, Illinois.*

*Atomic Industrial Forum, Conference on Management, Economics, and Technology for the Atomic Industry. Identified by initials AIF, and obtainable by purchase from AIF, 3 E 54th St, New York 22, N. Y.*

1. Efficient Gear Design—alloy steel helical gearing is crown shaved for optimum tooth contact; induction hardened for long life. Overall efficiency of "IN-LINE" Reducers range from 95% to 98%.

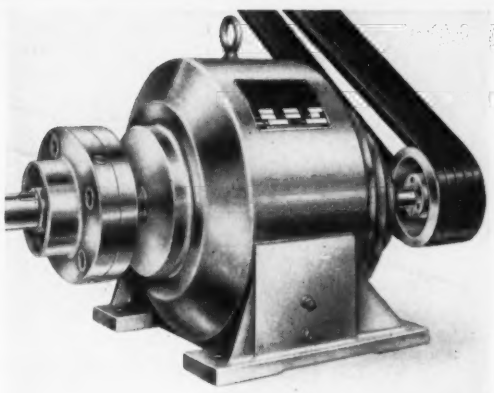
2. Rugged Housing—of corrosion resistant cast iron; designed to handle the toughest industrial service.

3. Large Overhung Load Capacity—is possible through the use of extra heavy bearings and shafting both on high and low speed shafts. "IN-LINE" Reducers are especially suitable for chain and V-belt drives.

4. Ample Oil Reservoir—assures maximum thermal capacity and positive splash lubrication of all gears and bearings.

# Phillie Gear "in-line" reducers where mounting space is limited . . .

The streamlined compactness of these new units makes them ideal for mounting in places where space is limited. Accurately manufactured helical gearing, rugged housing construction and precision mounted shafts and bearings assure long, dependable service, with a minimum of maintenance. The *new* Phillie Gear "IN-LINE" Reducers are available in 18 different sizes and gear reductions to suit most types of service . . . they are easy to place into service and suitable for mounting in various positions. Philadelphia "IN-LINE" Reducers provide the economical solution to a wide range of power transmission problems. Standard AGMA ratios from 1.25:1 to 205:1, in capacities up to 60 horsepower . . . Send for Catalog GM-560A, which fully describes and illustrates these rugged, efficient money-saving units.



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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

Virginia Gear & Machine Corp. • Lynchburg, Va.

# D.T. Williams and DETROIT CONTROLS

## the names are good

Reputation is a matter of record. And the record of D. T. Williams for dependability and performance has been firmly established over the years.

Now, as a part of Detroit Controls, the high quality is being maintained, so that you may continue to place your confidence in this product, assured of ready supply and good service.

## because the products are right

**No. 856 "Vulcodisc" Lift Check Valve**

Vulcanized asbestos disc. For 200 lbs. working steam pressure at 500° F. or 400 lbs. working non-shock gas and liquid pressure at 150° F. Installed in horizontal position. Screw cap and screw ends.

**No. 1086 Swing Check Valve**

Vulcanized asbestos disc. For 200 lbs. working steam pressure at 500° F. or 400 lbs. working non-shock gas and liquid pressure at 150° F. Installed in horizontal or vertical position. Screw cap and screw ends.

**No. 912 "Vulcodisc" Globe Valve**

May be used for steam or hot water with pressures to 200 lbs., temperatures to 500° F.; or water, gas and air to 400 lbs. at 150° F.; for oil to 200 lbs. pressure at 250° F.

**No. 833 Horizontal Check Valve**

Renewable composition, air disc, integral seat, screw ends, spring loaded disc. 300 lbs. working non-shock gas and liquid pressure at 150° F.

**These valves meet all government, marine and industrial specifications.**

Quality Protects Your Investment--

AMERICAN-Standard Quality Is Available At No Extra Cost.

Bridgeport 1, Connecticut

DETROIT CONTROLS

Division of AMERICAN-Standard


# APPOINTMENTS

## Corporation executive changes

**The Cooper-Bessemer Corp:** Eugene L Miller, president and general manager; Ralph L Boyer, vice-president and director of engineering. **Calumet & Hecla, Inc:** Horace Y Bassett, president and chief executive officer. **C&D Batteries, Inc:** John F Rittenhouse, president; Louis M Eble Jr, vice-president. **Fairbanks, Morse & Co:** Robert H Morse Jr, president and chief executive officer; Gordon R Anderson, vice-president, engineering; F M Mason Jr, vice-president, government business.

**Borg-Warner Corp:** Howard E Morison, vice-president, Ingersoll Steel division. **Baldwin - Lima - Hamilton Corp:** Perry A White, vice-president and general manager, Eddystone division; Robert G Tabors, vice-president and general manager, Electronics & Instrumentation division. **Bailey Meter Co:** C E Sutherland, vice-president, manufacturing.

**Panellit, Inc:** Millard D Shriver, vice-president and assistant to the president. **Western Precipitation Corp:** R F Stewart, vice-president. **Burgess-Manning Co:** S G Paddock, executive vice-president. **The Kuljian Corp:** Edward J Healy, vice-president, construction. **Alco Products, Inc:** Edward N Cooley, vice-president. **Federal Pacific Electric Co:** Leonard Shelley, vice-president.

**Mexico Refractories Co:** Lloyd L Brightman, vice-president and general manager. **Hill Transformer Co, Inc:** Walter F Dimmick, executive vice-president.

## Institute elections

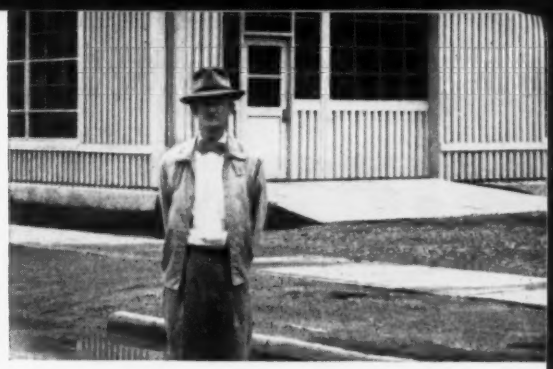
**American Institute of Electrical Engineers:** Walter J Barrett, president; Benjamin R Teare Jr, Herbert W Oetinger, Albert G Johnson, Orien A Gustafson and Gordon F Tracy, vice-presidents. **American Institute of Industrial Engineers:** Gordon B Carson, president. **National District Heating Association:** John C Haroldson, president; William G Gillim, 1st vice-president; George F Prestwich, 2nd vice-president; Albert F Metzger, 3rd vice-president.

**Oil-Heat Institute of America, Inc:** J V Resek, president; G M Marin, Stanley Czarnecki and J Hollis B Albert, vice-presidents. **Fluid Controls Institute, Inc:** John S Leslie, president; Dean E Madden and Marshall B Taft, vice-presidents.

## Engineer changes

**Beckman Instruments, Inc:** Anthony Del Duca, chief electronics engineer, Process Instruments division; Ernest M Whitley, production engineer, Spinco division. **General Nuclear Engineer-**

# "... no one could go wrong in buying a Nordberg engine ..."



**says Mr. Walter Scales**
*Manager*
**Conway Corporation**
**Conway, Arkansas**

The Conway Light, Power and Water System is owned by the City of Conway, Arkansas, and operated by the Conway Corporation. Mr. Walter Scales, its manager, has this to say about Nordberg power:

"*Our first Nordberg engine was installed late in 1951. That engine now has over 36,000 hours of running time on it. During the calendar years 1952 thru 1956 the engine was on the line 75% of the possible running time. During one period of 43 consecutive months the engine was operated over 90% of the possible running time and accounted for 75% of our total plant generation during that period.*

"*Our second Nordberg went into operation in 1956 and now has over 8,000 hours on it. There is every indication that it will be as satisfactory, and even more economical, than the first engine. Our opinion is that no one could go wrong in buying a Nordberg engine.*"

When you need *long-term, dependable* power, consult Nordberg . . . builders of a full line of engine sizes from 600 to over 12,000 hp, including Diesel, Duafuel® and Spark-Ignition Gas types.
*NORDBERG MFG. CO., Milwaukee, Wisconsin*

***Installation Data:***

*City of Conway, Arkansas:*

Two Nordberg 2-cycle Duafuel® engines installed, total of 6225 hp.

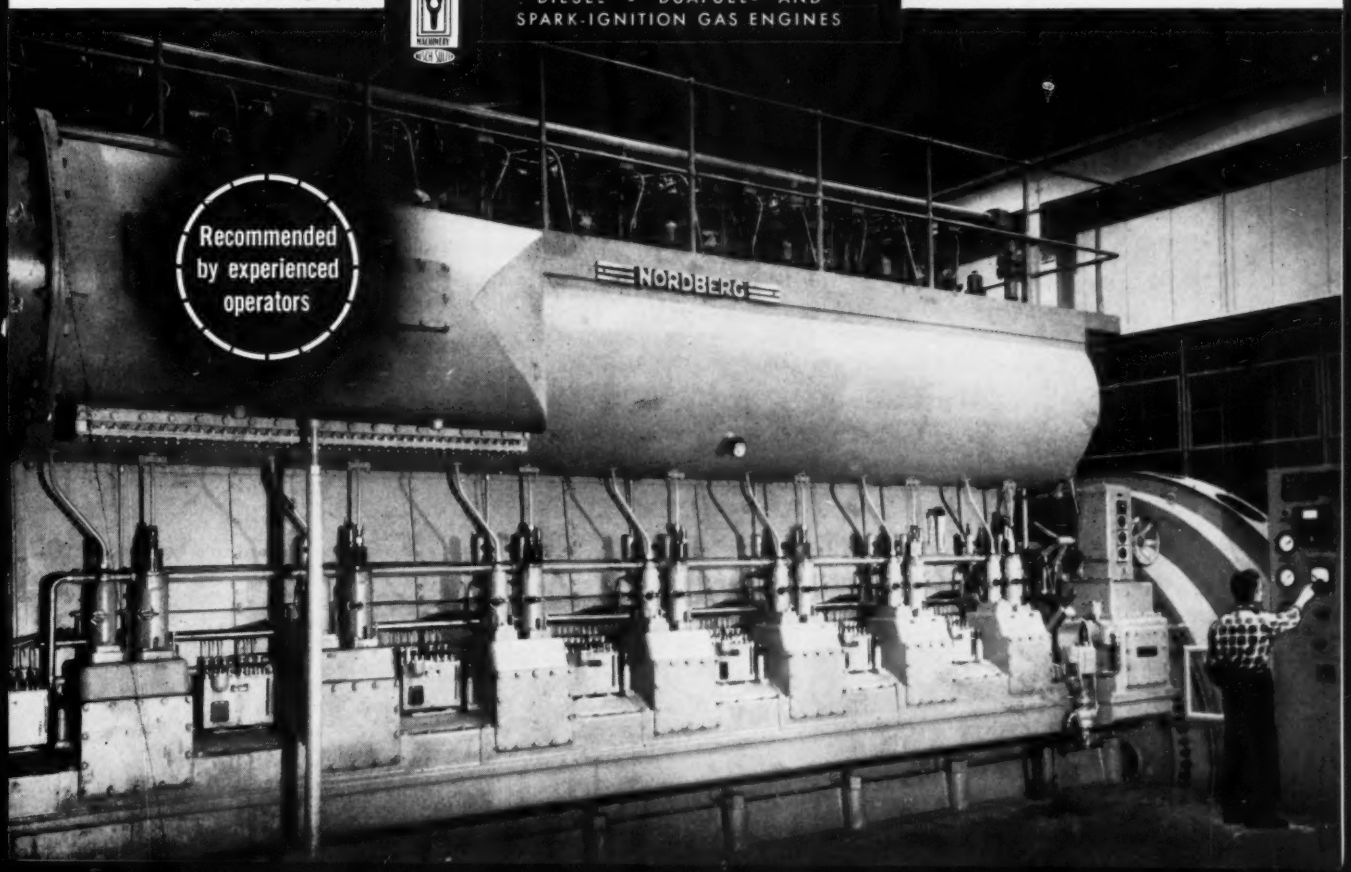
- First engine installed late 1951 . . . rated 2750 hp, 1940 kw.
- Second engine installed late 1955 . . . rated 3475 hp, 2470 kw.

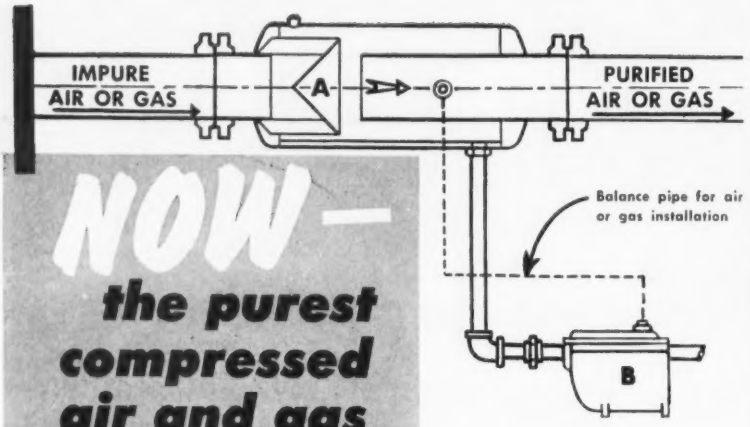
**NORDBERG**

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

© 1957, Nordberg Mfg. Co.

P657



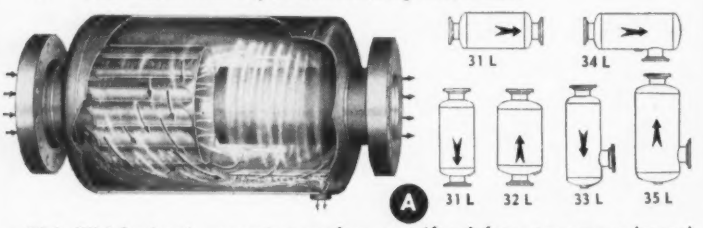



**NOW— the purest compressed air and gas is yours with this W-A equipment**

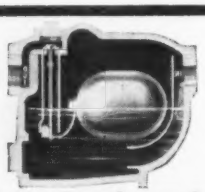
**GUARANTEED TO REMOVE 99% OR MORE OF ENTRAINED MOISTURE AND SOLIDS**

Where pipe lines carry compressed air and gas, liquids and solids are generally entrained in the gas stream. Wright-Austin 30L Series Separators can be used to remove foreign matter on a wide range of applications. For operating pressures to 5000 PSIG. Line sizes to 24". Here are some typical applications:

REMOVE
—oil and water from compressed air supply lines
—oil and water on compressed air service at outlet of inter-cooler and after-cooler equipment.
—oil, moisture and tar between stages in coke oven gas compressors
—oil and water from $CO_2$ gas lines
—oil and water from hydro-carbon lines
—entrainment from vapor lines following evaporation




This Wright-Austin separator employs centrifugal force to remove impurities from steam, air or gas flow. The pressure drop is extremely low. Type 31L, as well as other models shown, is light weight, compact and sturdily constructed according to ASME code.



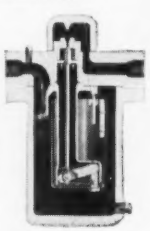
**23-AC TRAP** (0-125 PSIG)

Separated condensate flows to trap. Drainage is automatic. Particularly adapted where cold, gummy, emulsified cylinder lubricants make ordinary traps inoperative.

B

**101-AC TRAP** (0-600 PSIG)

Cast steel body, cover and bonnet. Designed for draining condensate where high pressures are involved. Internal mechanism all attached to cover for easy service.



WRIGHT-AUSTIN COMPANY
3245 WIGHT STREET • DETROIT 7, MICH.

**WRITE FOR NEW CIRCULAR 506-A**


# More APPOINTMENTS

Begins on page 224

**ing Corp:** Jack C Clapp, Robert W Deutsch, Albert S Jameson, William L Kitterman and Herbert C Stevens, nuclear engineers. **Pittsburgh Piping and Equipment Co:** William J Titzell, chief engineer. **McGill Manufacturing Co, Inc:** Ray A Bouvier, chief engineer, electrical division. **Formsprag Co:** Roger L Daniels, chief engineer. **Milton Roy Co:** John P Klembeth, asst chief engineer. **The Cooper-Bessemer Co:** R F Kymer, asst chief engineer, products division; M J Helmich, asst chief engineer, development division. **Niagara Mohawk Power Corp:** Harold I Howell, staff engineer; J Norton Ewart, chief system project engineer; Earl B Strowger, system project engineer, hydroelectric stations; Franklin S Helfter, system project engineer, steam electric stations.

## Sales changes

**Milton Roy Co:** John Procopi, sales manager. **Panellit, Inc:** William B Denniston, sales manager. **Lamson Corp:** W Gerald Lanterman, sales manager, industrial division. **Rockbestos Products Corp:** Richard H Bamford, sales manager.

**Norden-Ketay Corp:** Francis P Halas, Midwest regional sales manager. **Allis-Chalmers Manufacturing Co:** S M Austin, sales manager, heat transfer products; T J Hodan, sales manager, water conditioning products. **H K Porter Co, Inc,** refractories division: Charles C Flory, Pittsburgh district sales manager. **The Cooper-Bessemer Corp:** Richard J Wheelock, Chicago district manager.

**Square D Co:** K R Stull, Greater New York district manager. **National Electric Products Corp:** W R McCaskey, Pittsburgh district manager; E M Nelson, Chicago district manager; D F Dimock, Mideastern regional manager; H E Colliver, Midwestern regional manager.

## New distributors

For **Automatic Switch Co:** Leighton Stone Corp, 770 Folsom St, San Francisco 7, Calif.; John N Fehlinger Co, Inc, 5 Beekman St, New York 38, N. Y.; Western Machinery Co, 1035 SE 9th Ave, Portland 14, Ore.; and Evansville Supply Co, Esco Bldg, 800 Block Pennsylvania St, Evansville 8, Ind. For **Hills-McCanna Co:** Republic Supply Company of California, 1919 Williams St, San Leandro, Calif. For **Boston Woven Hose & Rubber Co:** Dixon Supply Co, 425 S 20th St, Birmingham 3, Ala. For **Ampco Metal, Inc:** Non-Ferrous Castings Co, Inc, 736 Albany St, Dayton 8, Ohio; E A Williams & Son, 325 Washington Ave, Carlstadt, N. J.; and Tennessee Die Supply Co, Inc, 314 Howerton St, Nashville 6, Tenn.

(*Continued on page* 228)

HAGAN RING BALANCE FEATURES — NO. 1

## TRIGONOMETRY OF

# UNIQUE RANGE CALIBRATION SYSTEM

# PROVIDES HIGH SENSITIVITY AT LOW FLOWS

Low-flow sensitivity is a built-in feature of the Hagan Ring Balance flow meter. Rotation of the ring, in response to differential, is governed by the adjustable range spring in accordance with the unvarying trigonometry of the range calibration mechanism. This is expressed by the formula:

$$\text{Spring deflection} = R(1-\cos\theta) - L(1-\cos\phi),$$

and is graphically illustrated at the right. The upper curve shows that the ring motion at low range exceeds the requirement to produce pen motion linear with flow. Thus, the cam which transmits ring motion to the pen arm can convert this excess ring motion into extra power for precise pen movement.

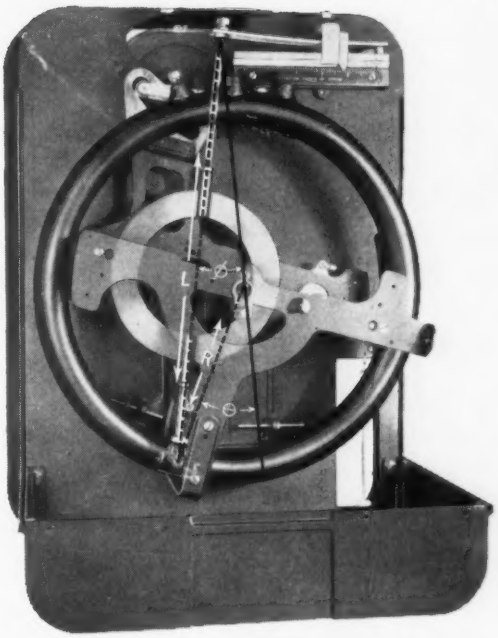
**METERING APPLICATIONS WHICH REQUIRE WIDE TURN-DOWN CALL FOR HAGAN RING BALANCE METERS.** You get this feature when you specify Hagan, as well as the following:

1. Ease of calibration under operating static pressures with factory calibrated check weights! No more four-story water columns and telephones!
2. Safe operation with rings rated at 2,500, 10,000, 15,000 psig. No gaskets, no stuffing boxes.
3. Sealing fluid density and level not critical. No eyedroppers required.
4. Interchangeable ring assemblies for full scale ranges from 0.5″ w.c. to 560″ w.c. Adjustment on any one ring over a 7:1 differential range.
5. Wide range computation and/or compensation by means of built-in, easily checked mechanisms available on most models.
6. Pneumatic or electric transmission also available.

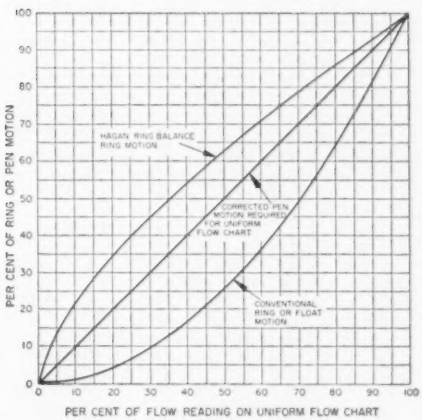
Bulletin MSP-141 describes these features and the new design of the Hagan Ring Balance meter case. ASK US FOR IT.

**HAGAN CHEMICALS & CONTROLS, INC.**

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY · HALL LABORATORIES



Push rod moves upward against range spring, governing ring rotation in accordance with the diagram below.


PER CENT OF RING OR PEN MOTION
HAGAN RING BALANCE RING MOTION
CORRECTED PEN MOTION REQUIRED FOR UNIFORM FLOW CHART
CONVENTIONAL RING OR FLOAT MOTION
PER CENT OF FLOW READING ON UNIFORM FLOW CHART

Excess motion of the Hagan ring, as shown by upper curve, is converted (with a gain in torque) into linear pen movement by a gently sloping cam.

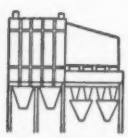
New, rigid, weatherproof, die-cast, aluminum case. Four-piece back for complete accessibility.

# How to tame a dust collection problem

Look for the 'hidden' factors that deliver important *extra efficiency*, like the exclusive Shave-off in Buell Cyclones that harnesses the double-eddy currents to trap an extra percentage of dust. Side-entry of gases, Buell-designed manifolds, proper proportioning, extra-heavy-plate construction provide even more efficiency. Send for the ready reference booklet, "The Collection and Recovery of Industrial Dusts". Dept. 50-H, Buell Engineering Company, Inc., 70 Pine Street, New York 5, N. Y.

BUELL CYCLONE

"SF" ELECTRIC PRECIPITATOR



PRECIPITATOR-CYCLONE COMBINATION

buell®

*Experts at delivering Extra Efficiency in*

**DUST COLLECTION SYSTEMS**


# More APPOINTMENTS

*Begins on page 224*

## New representatives

For **Blaw-Knox Co,** Copes-Vulcan division: Herr-Harris Co, 1203 Grant Bldg, Pittsburgh 19, Pa. For **Henry Pratt Co:** Ralph L Stemler Inc, 1232 Ridge Ave, Pittsburgh, Pa. For **Calumet & Hecla, Inc,** Wolverine Tube division: George E Reade, 1580 Sherman St, Evanston, Ill. For **Industrial Gear Manufacturing Co:** William J Schaller, 5200 N Santa Monico Blvd, Milwaukee, Wis.

## Retirements

**Charles L White,** district manager of the North Central States area, The Cooper-Bessemer Corp, after 28 years of continuous service.

**Bruno Thiel,** supervisor of compression engineering, The Cooper-Bessemer Corp, after 46 years of continuous service with the company.

**Glen H Rearick,** member of the vice-president's staff and former manager of two plants of The Babcock & Wilcox Company's Tubular Products division, after 41 years of service.

## Obituaries

**Leon A Doughty,** 70, president and co-founder of C&D Batteries, Inc, on May 18.

**W T Stevenson,** 56, president of Texas Gas Transmission Corporation, on May 22.

**Harry Stanley Rogers,** 66, president of the Polytechnic Institute of Brooklyn, on June 6.

**James E E Royer,** 72, retired vice-president and general manager of Washington Water Power Co, on May 22.

**Harry T Paterson,** 46, operational manager of the Harbor Island and Kure Beach corrosion test stations of The International Nickel Co, Inc, on May 27.

**James Emmett Jr,** 50, vice-president in charge of sales for Jas P Marsh Corporation, on June 7.

*"No thanks, keeps me awake."*

# 5 Peerless Pump Designs

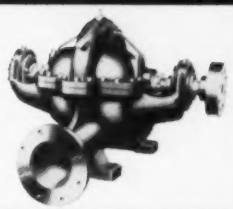
## *that squarely meet every* LIQUID HANDLING REQUIREMENT

PEERLESS PUMPS

| THESE ARE THE *Pumps* | ASK FOR *FREE* ENGINEERING BULLETINS |
|---|---|

**TYPE A AND TYPE AS GENERAL PURPOSE PUMPS**

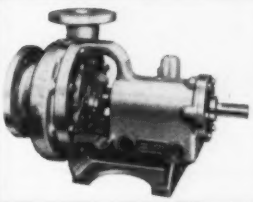
Use these pumps in the widest range of water handling services. Single stage, horizontal split case design. Mechanical shaft seal construction available in sizes up to 4" (Type AS). Heads: up to 300 ft.; capacities up to 70,000 gpm.



*Ask* FOR BULLETIN **B-1300 & B-1350**

**TYPE DL AND DM CHEMICAL PROCESS PUMPS**

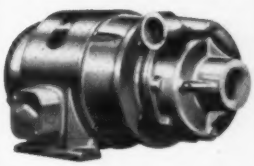
Combine quality with economy through a practical idea of component interchangeability between pump types. Oil and grease lubricated bearing housings. Packing gland or shaft seal designs. Air or water cooled back plates. Heads to 430 feet; capacities to 800 gpm. Pressures to 400 psig.



*Ask* FOR BULLETIN **B-1608**

**TYPE PE AND TYPE PB END-SUCTION PUMPS**

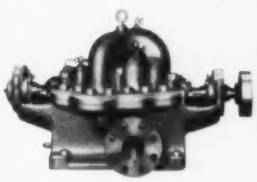
America's broadest line of economical, general purpose pumps. Horsepower range from ¼ to 150. Head range to 260 ft. Capacities up to 5500 gpm. Easy to buy, apply, install and maintain. Tens of thousands in use.



*Ask* FOR BULLETIN **B-2300**

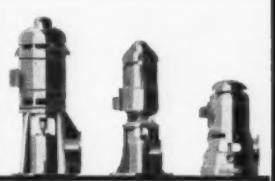
**TYPE TU AND TYPE TUT MULTI-STAGE PUMPS**

2,3,4 and 5-stage designs for supplying, circulating and boosting water and other liquids in moderate capacities against medium and high heads. Durable and dependable in operation. Heads up to 1660 feet; capacities up to 3000 gpm.



*Ask* FOR BULLETIN **B-1400**

**VERTICAL INDUSTRIAL SERVICE PUMPS** Heavy duty, extra heavy duty and process service types for application to cooling tower service, tank pumping, etc. One of the proudest lines manufactured. Save on piping, always primed, require minimum floor space. Heads to 1000 feet; capacities: 30 to 40,000 gpm. HP range: up to 2500 h.p.



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**MAIL COUPON FOR ILLUSTRATED BULLETINS**

**PEERLESS PUMP DIVISION**
*FOOD MACHINERY AND CHEMICAL CORP*
***Factories:*** Los Angeles, Calif., and Indianapolis, Ind.
***Offices:*** New York; Atlanta; Chicago; St. Louis; San Francisco; Phoenix; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque, New Mexico.
*Distributors in Principal Cities; Consult your Telephone Directory*

PEERLESS PUMPS

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

PEERLESS PUMP DIVISION
*FOOD MACHINERY AND CHEMICAL CORPORATION*
301 W. Ave. 26, Los Angeles 31, California
Please send Bulletins checked below

- ☐ Type A Bulletin B-1300
- ☐ Type AS Bulletin B-1350
- ☐ Type DL-DM Bulletin B-1608
- ☐ Type PE-PB Bulletin B-2300
- ☐ Type TU Bulletin B-1400
- ☐ Vertical Types Bulletin B-505

NAME _____

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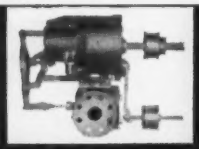
CITY _____ STATE _____

POW

STOP WASTING STEAM



Type EN Governor Fully enclosed, Self-lubricated

Let Troy Steam Engines and Generators produce dollar-saving "BY-PRODUCT POWER" from steam available for processing or heating. You can use this low-cost power for many operations in your plant, even against high back pressures!

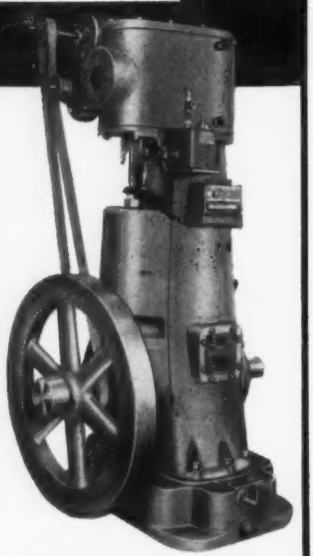
Use it for—

Generating Electrical Power

Mechanically Driving stokers, pumps, fans, compressors and other equipment.

It will pay you to investigate this source of cheaper power. TROY Equipment can be your key to COST REDUCTION!

*Send for Booklet #306.*



Type E. Engine, 12.5 to 100 HP.

TROY **TROY** Engine & Machine Co.

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precise control

20 TURNS moves the stem only 3/8"

For precision flow control use this brass or stainless steel bar stock metering valve, equipped with an O-ring stem seal. The extra long, sharp, needle point stem (8° included angle) and fine spindle threads insure accurate control for pneumatic or hydraulic service, or precision laboratory work. In 1/8" and 1/4" pipe sizes. Your choice of 1/16" or 1/8" orifices. Available for Panel Mounting, too.

For complete information send for Bulletin No. BSV 256.

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*Coming in September*

* * *

**Power's 75th ANNIVERSARY ISSUE**

WATCH FOR IT!

# Is Industry Creating A New Breed of "Bonus Babies"?

THE STARTING SALARIES offered to this year's June graduates give the impression that industry is creating a new breed of "bonus babies." This is the term baseball fans apply to sturdy youngsters whose talent for hitting and throwing gets them payments of up to $100,000 and other benefits for signing a contract.

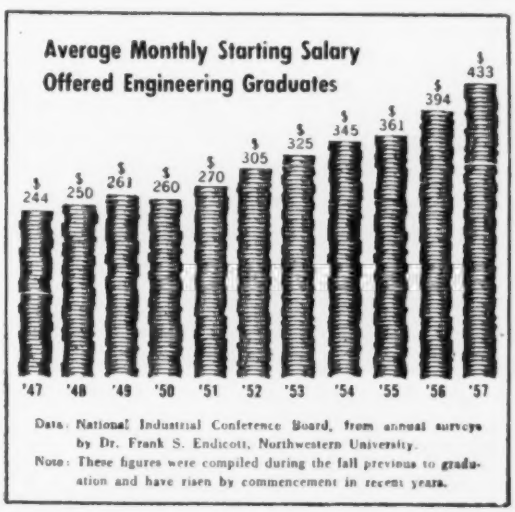
For several years industry's demand for young college graduates, especially in science and engineering, has outrun the number receiving degrees. Competition for these young people has steadily pushed up the starting salaries and has induced many companies to indulge in lavish recruiting programs. This year engineering graduates are being offered well over $400 a month, and even liberal arts graduates find numerous offers at $400 or more. Only ten years ago the salaries offered senior engineering students averaged less than $250 a month.

**But any employer who assumes that high starting salaries alone will assure him the number of June graduates he wants is likely to be disappointed.** A recent study by the McGraw-Hill Classified Advertising Division shows that most young engineers and scientists going into industry are more interested in their opportunities and in a company's future than they are in the size of their first paycheck.

## Money Isn't Everything

In the McGraw-Hill survey, 2,596 recently-hired engineers and scientists employed in 57 companies listed the factors they had considered before accepting a position. The replies of the younger engineers and scientists—those with less than five years' experience – have great significance for employers who want to make any impression in the highly competitive market for college graduates.

- **Potential growth of the company** was listed by more young engineers and scientists than any of the 42 other items on the list as a factor that influenced greatly their decision in accepting a position.
- **Challenging opportunity** was second.
- **The company's prestige and reputation** ranked third.




Data: National Industrial Conference Board, from annual surveys by Dr. Frank S. Endicott, Northwestern University.
Note: These figures were compiled during the fall previous to graduation and have risen by commencement in recent years.

● **Progressive research and development program** was fourth.

● **Starting salary** ranked only **seventh.**

## Job and Future Most Important

**As a group, the factors relating to the nature of the job, its future and the company's future had by far the greatest influence in attracting young engineers and scientists to their present positions.** These include three of the top four attractions—potential growth of the company, a challenging opportunity and a progressive research and development program. Other factors in this group are the company's facilities, quick advancement, self-direction or little supervision, chance to work in a certain field, small size of company and rewards for individual accomplishment.

**The second most important group of attractions had to do with prestige.** These include the company's prestige and reputation, executive or professional standing and association with leading men in the field. **Third in importance were financial considerations** — starting salary, regular salary increases, financing of relocation, paid vacations and holidays.

**A less important group of factors influencing young scientists and engineers were essentially social.** Geographic location and educational facilities in vicinity ranked fairly high. But recreational facilities, suburban or country living, pleasant housing and cultural considerations had little appeal.

**Ranking lowest, by a good margin, were factors having to do with security**—permanent position; health, life and surgical insurance; retirement or pension plan; and sick leave.

It is interesting to note that some of the factors which influenced the **smallest** percentage of young engineers and scientists were country club memberships, use of company car, at-cost or low-cost eating place, travel opportunities abroad and being able to buy the company's products at a discount.

## A Lesson For Employers

The lesson of this survey to employers who hope to recruit more young engineers and scientists is clear. High salaries and other financial appeals are important. But, **at a time when high starting salaries are offered in abundance, our young graduates are interested even more in being with companies that will grow and in jobs that will permit them to grow. They are interested in jobs that offer opportunities for advancement, financially and professionally.**

* * *

Were the young scientists and engineers who participated in the survey trying to impress somebody with their motives? If so, it could only have been to impress themselves, for all were asked to return their questionnaires unsigned.

**What Factors Influence the Job Selections of Young Engineers and Scientists?**

| Factors Influencing Decision Greatly | Percent Listing Factor |
|---|---|
| Potential growth of company | 55% |
| Challenging opportunity | 53 |
| Company's prestige, reputation | 44 |
| Progressive research and development program | 41 |
| Geographic location | 37 |
| Permanent position | 35 |
| Starting salary | 34 |
| Educational facilities in vicinity | 33 |
| Regular salary increases | 31 |
| Chance to work on specific project, or in certain field | 27 |
| Company's facilities (laboratories, technical libraries, etc.) | 25 |
| Tuition for graduate study | 25 |

**Based on replies by recently-hired engineers and scientists with less than five years' experience to questionnaire distributed by McGraw-Hill Classified Advertising Division.**

*This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.*

Donald C. McGraw
PRESIDENT

**McGRAW-HILL PUBLISHING COMPANY, INC.**

# WHEN THE HEAT'S ON...

## you can't beat "Featherweight" insulation!

Let's face it—when the chips are down, and heat insulations are being weighed in the balance, you just can't do better than K&M "Featherweight"® 85% Magnesia for its important temperature range.

If the bulk of your heated lines and equipment falls in the below-600° F range, you need "Featherweight." If your insulation must resist thermal shock and routine mechanical abuses, you need "Featherweight." If your plans call for all-around proven efficiency that lasts the life of the insulated equipment, you need "Featherweight."

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**COMPANY • AMBLER, PENNSYLVANIA**
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**FOR TEMPERATURES UP TO 1900° F**... economical "Featherweight" is used on this high-pressure heater in double-layer staggered-joint application with K&M Hy-Temp Insulation. First layer, Hy-Temp, brings surface temperature down to 600°F or below; "Featherweight" layer does the rest. You save in initial cost, and again in long-run heat-conservation.

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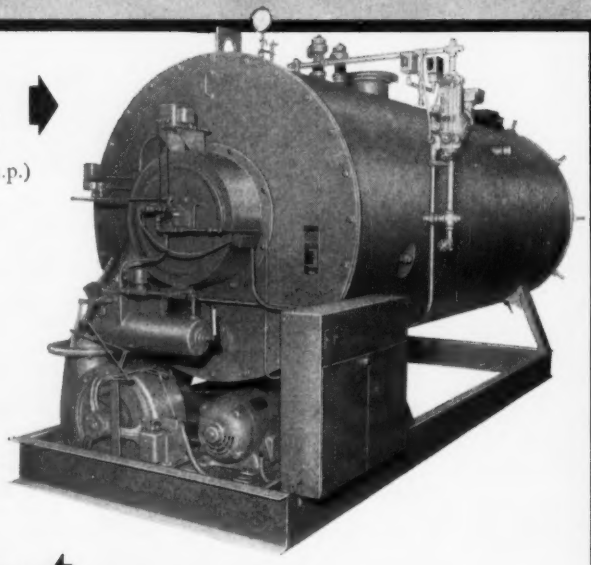
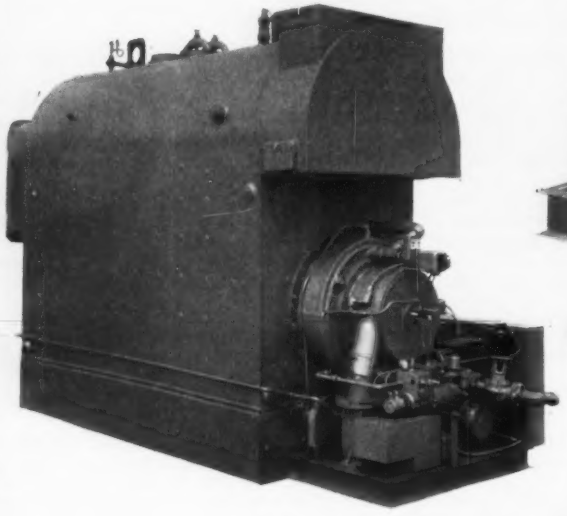
## specify YORK-POWER

No longer are automatic boilers limited to one type of boiler. York-Power now offers a complete selection—2-pass Scotch Marines, 3-pass Scotch Marines, and 4-pass Fire Tubes—in a complete range of sizes. All York-Power boilers are automatically fired with oil or gas and can be furnished for combination gas-oil firing. All York-Power automatic boilers are complete on one skid and are fully wired. All York-Power automatic boilers are fire-tested for operational efficiency.

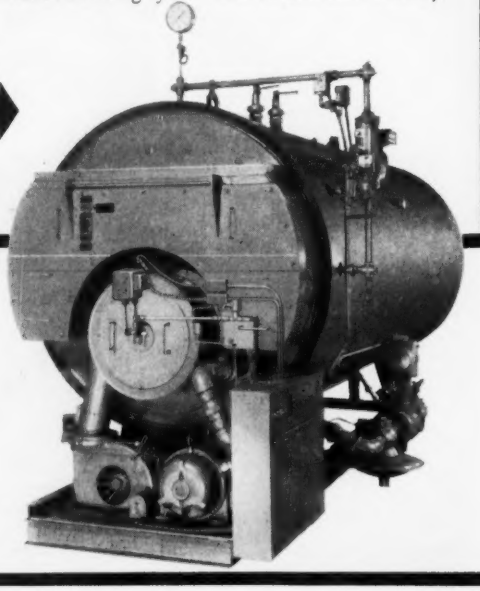
***Steam-Pak Automatic Boilers***
featuring 3-pass Scotch Marine design • High or Low Pressure Steam or Hot Water • 15 to 600 Horsepower
(Also available in Steam-Pakette design from 10 to 50 h.p.)





***Fire-Pak Automatic Boilers***
featuring 4-pass Fire-Tube design • Low Pressure Steam or Hot Water • 35 to 485 Horsepower
(Steam-Pak firing system with forced draft burner)

***Scot-Pak Automatic Boilers***
featuring 2-pass Scotch Marine design with either forced, induced or natural draft.
45 to 400 horsepower



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The advertising rate is $17.90 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

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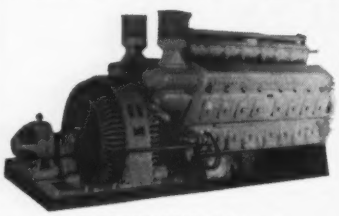
*Send New ADS or Inquiries to Classified Adv. of Power, P. O. Box 12, New York 36, N. Y., For September Issue Closing August 12th.*

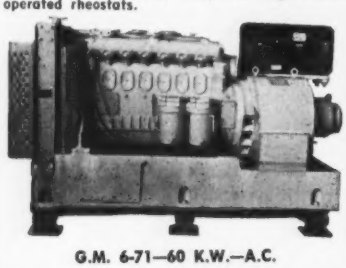
# OUTSTANDING VALUES!

## DIESEL DRIVEN GENERATORS — PRICED TO SELL



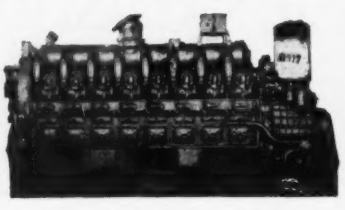
**G.M. 16-567—1250 KVA—A.C.**

1250 KVA 4600/2300 volt 3 phase 60 cycle 720 RPM Westinghouse sync. A.C. generator—80% P.F.—S.O. 6P455 with direct connected 10 KW exciter. Spare parts include (1) factory reconditioned blower; (1) extra blower; and a quantity of new pistons, liners, heads, bearings, etc. Unit complete with Westinghouse oil circuit breaker —15000 volts—type F-124—600 amps—60 cycle —solenoid operated—mounted in drawer-type cubicle 20" wide—44¼" deep—88" high. Motor operated rheostats.



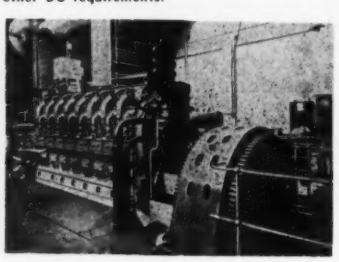
**G.M. 6-71—60 K.W.—A.C.**

GM 6-71 radiator cooled self-contained diesel generator sets—60 KW 440 or 220 volts 60 cycle 3 phase 1200 RPM with direct connected exciters and self-contained panel boards, including rheostats, SilverStat voltage regulator, ammeters, voltmeters. These units are guaranteed to be in perfect running condition and can be demonstrated at our plant. The generators were made by Delco and are ball-bearing drip-proof marine type. Engines are famous GM 6-71 6-cylinder 2-cycle 4¼ x 5—equipped for electric starting. Equipped with radiator, self-contained fuel tank, all controls, etc. Mounted on pre-fab sub-base. 8 available.



**G.M. 16-278A—1200 KW—D.C.**

(1) 16-278A diesel generator set. GENERATOR: 1200 KW—525 volts DC—3000 amps—720 R.P.M. —shunt wound. (Generator not shown) ENGINE: #11977—complete with full flow filters; Harrison heat exchangers; strainers; pyrometers, etc. 1600 HP at 720 RPM—formerly in Navy DE. Never in commercial use. Generator is totally enclosed air-cooled drip-proof marine type mfg. by Allis-Chalmers. Excellent for dredges and other DC requirements.



**1250 KVA DIESEL A.C. POWER PLANT**

Modern 1250 KVA 1000 KW 420 volt 3 phase 50 cycle 4-wire diesel driven alternator set, mounted on a fabricated baseplate and direct coupled at 750 RPM, incorporating: ENGINE—G.M. 16-278A —#11691, dated 1943; 1700 b.h.p. 16-cylinder 2-stroke cycle; cold starting; cylinders 8¾" x 10½"; complete with hydraulic governor and overspeed trip. Direct coupled to: ALTERNATOR —by Electric Machinery Co—#97688. Revolving field, 0.8 P.F.; 1720 amp. per phase; 750 RPM; single pedestal oil ring lubricated bearing; direct coupled exciter 12.5 volts 52 amps. Engine has standard fittings and ancillaries.

## The BOSTON METALS Co.

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**CURTIS 7-5050** **LEXINGTON 9-1900**

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Permanent staff positions open for graduate mechanical engineers with 3 years minimum experience as Project Engineer in design of steam electric power plants. Salary will be commensurate with experience and ability. Excellent working conditions. Liberal company benefits.

Please give full details—including personal data, education, experience and salary desired in your reply.

*Write or call collect, to:*

**THE KULJIAN CORPORATION**

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**STevenson 2-9000**

**WANTED CHIEF ENGINEER**

For municipal electric generating utility. 3,750 steam turbine plant, 450# press. expansion in steam plant planned. Located in Southwestern Minn. Chief engineers license required, electrical experience desired. Retirement and Hospital insurance benefits. Replies confidential. Give age, previous experience and lowest starting salary.

**WRITE: P-5558, POWER**
**520 N. Michigan Ave., Chicago 11, Ill.**

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Sales engineers established 25 years with own shop and warehouse want automatic control, instrument or mechanical equipment line. Calling on industry engineers, contractors and government.

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B&W boilers sectional header type. Also fire tube boilers. Write to:

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**Specialists in Aviation, Electronics and Nucleonics**

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**Steam Engineer—Municipality in deep south with** 35,000 KW steam electric generating station has immediate opening for a mechanical or electrical engineer with steam background. Excellent opportunity for advancement leading to superintendency. Send resume giving complete information on educational background and work experience. All applications will be handled confidentially. P-5433, Power.

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**LARGE ELEC. POWER EQUIPMENT**
**SELECTED STOCK ITEMS**
**RE-NU-BILT—GUARANTEED—RE-NU-BILT**
**COMBINATION MILL DRIVES—**
**D.C. MOTORS WITH M.G. SETS & CONTROLS**
**PACKAGE DRIVES IN STOCK**

1—1375 H.P. G.E., MCF, 415 V, 1300 RPM D.C. motor with 1100 KW G.E. MG Set 415 V. DC, 2300/4000 V, 720 RPM 3 ph 60 cycle.

1—1200 HP G.E. MPC, 600 V, D.C. Motor, 450 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 EP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

1—850 HP, G.E., Type MCF, 260 volt DC, 800/1200 RPM, and 675 KW, M-G Set, DC Gen., G.E., Type MCF, 260 volt, DC, with 1100 HP, .7 PF G.E. Synch. Motor Type ATI 2300/4600 volt, 900 RPM, 3 phase 60 cycle.
Above with variable voltage control.

### A. C. MOTORS—3 Ph. 60 Cy.

**SLIP RING**

| Qu. | HP | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 1 | 1750 | G.E. | M-579BS | 4800/2400 | 1800 |
| 1 | 1500 | G.E. | MT | 6900 | 1187 |
| 1 | 1100 | F.M. BB | SF806S | 4800/2400 | 1800 |
| 1 | 750 | G.E. | MT-573 | 2200 | 1190 |
| 1 | 700 | Al. Ch. | D.P. | 2300 | 500 |
| 1 | 600 | Whse. | CW-432D-15 | 440 | 1778 |
| 1 | 500 | Whse. | CW | 550 | 350 |
| 1 | 400 | Whse. | CW | 440 | 514 |
| 1 | 350 | Cr. Wh. | SIZE-718R | 208/406 | 1765 |
| 1 | 350 | G.E | IM-17A | 440/2200 | 720 |
| 1 | 350 | Whse. | CW-1039C C-15 | 440 | 720 |
| 1 | 250 | Cr. Wh. | MT-424Y | 4000 | 257 |
| 1 | 250 | G.E. | SIZE-290 | 2300 | 350 |
| 1 | 250 | A.C. | | 550 | 600 |
| 1 | 200 | G.E. | IM | 2200 | 580 |
| 3 | 200 | G.E. | IM | 2200 | 435 |
| 1 | 200 | G.E. | MT-557Y | 2200 | 1760 |
| 1 | 150 | Whse. | CW30E17 | 2300 | 435 |

**SQUIRREL CAGE**

| | | | | | |
|---|---|---|---|---|---|
| 1 | 800 | G.E. | KT-573 | 2200 | 1180 |
| 4 | 500 | Whse. | CS-1216 | 2200 | 500 |
| 2 | 450 | Whse. | CS-1420 | 2300/4150 | 354 |
| 1 | 400 | G.E. | 1K | 2200 | 500 |
| 1 | 200 | G.E. | 1K-17 | 440 | 580 |
| 2 | 200 | G.E. | KT-557 | 440 | 1800 |
| 1 | 150 | Whse. | CS | 440 | 580 |
| 1 | 150 | G.E. | IK-15A | 2300 | 860 |

**SYNCHRONOUS**

| | | | | | |
|---|---|---|---|---|---|
| 1 | 7000 | G.E. | ATI | 2240/6600 | 600 |
| 1 | 4350 | C.W. | 3501-SL | 13800/6900 | 514 |
| 2 | 1750 | G.E. | ATI | 2300 | 3600 |
| 1 | 1750 | G.E. | TS | 2300 | 900 |

**M-G SETS—3 PH. 60 CY.**

| Qu. | K.W. | Make | RPM | DC Volts | AC Volts |
|---|---|---|---|---|---|
| 2 | 2000/2400 | G.E. | 450 | 250/300 | 2300/4600 |
| 2 | 2100 | G.E. | 514 | 250/300 | 2300/4600 |
| 1 | 2000 | G.E. | 514 | 600 | 2300/4600 |
| 1 | 1500 | G.E. | 720 | 600 | 6600/13200 |
| 1 | 1000 | G.E. | 900 | 260 | 6600 |
| 2 | 1000 | G.E. | 720 | 600 | 6600/13200 |
| 1 | 1000 | G.E. | 514 | 600 | 6600/13200 |
| 1 | 750 | G.E. | 720 | 575 | 6600/13200 |
| 1 | 750 | G.E. | 720 | 125/250 | 2300/4600 |
| 1 | 500 | Whse. | 900 | 125/250 | 440 |
| 3 | 300 | G.E. | 1200 | 250 | 2300 |
| 1 | 300 | Whse. | 1200 | 600 | 2300 |
| 1 | 200 | Whse. | | 550 | 3300 |
| 1 | 200 | G.E. | 1200 | 250 | 550/3300 |
| 1 | 200 | Cr. Wh. | 1200 | 250 | 440 |
| 1 | 150 | Whse. | 1200 | 275 | 2300 |

**TRANSFORMERS**

| Qu. | KVA | Make | Type | PH. | Voltages |
|---|---|---|---|---|---|
| 1 | 3000 | G.E. | OISC | 3 | 3300x2300 |
| 1 | 1500 | G.E. | PYRANOL | 3 auto | 4000/4200/4400 |
| 2 | 1000 | G.E. | OISC | 1 | 13800x460 |
| 2 | 750 | G.E. | PUR | 1 | 4800x85/55 |
| 1 | 833 | G.E. | OISC | 1 | 13800x460 |
| 3 | 500 | KUHL | OISC | 1 | 13800x6900 |
| 3 | 200 | Al. Ch. | OISC | 1 | 2300x230/460 |

**FREQUENCY CHANGER SETS**

| Qu. | KW | Make | Freq. | Voltage |
|---|---|---|---|---|
| 1 | 5000 | G.E. | 60/50/60 | 660/11000/6600 |
| 2 | 2500 | G.E. | 25/62.5 | 2300/2300 |
| 1 | 1000 | G.E. | 25/58.3 | 4400/2300 |
| 1 | 500 | Al. Ch. | 25/60 | 11000/2300 |
| 1 | 200 | G.E. | 60/3000 | 440/800 |

### TURBO GENERATORS

| Qu. | KW | Make | Desc. |
|---|---|---|---|
| 1 | 10000 | Whse. | Condensing 650 lbs. 750° F.T.T. Surface Condenser Dir. Conn. Exciter. |
| 1 | 5000 | G.E. | Auto Extraction Condensing 650 lbs. 750° F.T.T. Auto. |
| 1 | 1000 | Moore | Auto. Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. |

## BELYEA COMPANY INC.

**43 Howell St., Jersey City 6, N. J.**

## GUARANTEED REBUILT POWER EQUIPMENT

**HERE'S A WIDE SELECTION FROM OUR GIANT STOCK**

### SLIP RING MOTORS

3 Phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

| HP | Make | Type | Speed |
|---|---|---|---|
| 2500 | *G.E. | MT | 257 |
| 1200 | *Al-Ch. | ANT | 1800 |
| 600 | *G.E. | MT | 450 |
| 500 | G.E. | M-6345 | 1200 |
| 300 | G.E. | IM-17B | 900 |
| 250 | *G.E. | IM | 720 |
| 200 | G.E. | IM | 600 |
| 200 | Westg. (2) | CW | 514 |
| 200 | *Westg. | CW-905-A | 514 |
| 150 | Cr.-Wh. | 50-R | 1800 |
| 150 | Westg. | CW | 450 |
| 125 | G.E. (2) | IM-15A | 600 |
| 100 | G.E. | IM-13A | 1800 |
| 100 | G.E. | MTC-5546 | 900 |
| 100 | G.E. | IM | 720 |
| 100 | G.E. | IM | 600 |
| 100 | G.E. | IM-15A | 450 |
| 75 | G.E. | MT-347 | 1200 |
| 75 | G.E. | IM | 1200 |
| 75 | Al-Ch. | ANY-223C | 1200 |
| 75 | G.E. | MT-350 | 900 |
| 75 | Al-Ch. | ANY-26F | 900 |
| 75 | Al-Ch. | ARY | 720 |
| 75 | G.E. | MT-352 | 720 |
| 75 | G.E. | MT-356 | 720 |
| 75 | G.E. | IM | 600 |
| 60 | Al-Ch. | ARY | 1200 |
| 60 | G.E. | MT-348 | 1200 |
| 60 | *G.E. | MT-536 | 1200 |
| 60 | *Westg. | CW-762C | 900 |
| 50 | Westg. | CW | 1800 |
| 50 | G.E. | IM-11A | 1800 |
| 50 | *Al-Ch. | ARY | 1200 |
| 50 | Westg. | CW-836A | 1200 |
| 50 | *G.E. | MT-538 | 1200 |
| 50 | Westg. | CW-656-A | 900 |
| 50 | G.E. | MT-336 | 900 |
| 50 | G.E. | MT-348 | 720 |
| 50 | Al-Ch. | ANY-26F | 600 |
| 50 | G.E. | IM | 450 |
| 40 | G.E. | MT-532 | 1200 |
| 40 | *G.E. | MT-336 | 900 |

### SLIP RING MOTORS

Crane & Hoist Service

3 Phase, 60 Cycle, 220 or 440 Volt

| HP | Make | Type | Speed |
|---|---|---|---|
| 80 | G.E. | MTG-5552 | 800 |
| 75 | Westg. | CI-756-A | 600 |
| 50 | Westg. | MW-3304 | 600 |
| 30 | G.E. | HICTENV | 600 |
| 25 | G.E. | MTC-5536 | 600 |
| 20 | Westg. | CI | 1200 |
| 11 | Westg. | CI-E464 | 900 |
| 10 | P & H | BW-8 | 1800 |
| 8 | P & H | BW-9 | 1200 |
| 5 | N. Wat. | WRC | 1200 |
| 3 | G.E. | MTC-5544 | 900 |

### SYNCHRONOUS MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 volts or higher)

| HP | Make | Type | P.F. | Speed |
|---|---|---|---|---|
| 1400 | Westg. | HG | .7 | 900 |
| 400 | Westg. | HG | 1.0 | 900 |
| 300 | G.E. | ATI | .8 | 720 |
| 300 | *Ideal | SMM | .8 | 257 |
| 275 | *G.E. (2) | ATI | 1.0 | 450 |
| 250 | Al.-Ch. | SYN | 1.0 | 1200 |
| 225 | G.E. | TS-8244 | 1.0 | 300 |
| 225 | Elec. Mchy. | | 1.0 | 360 |
| 190 | Elec. Mchy. | | 1.0 | 720 |
| 150 | Al-Ch. (2) | SYN | .8 | 1200 |
| 150 | Fair.-Mer | TJC-285 | .8 | 720 |
| 150 | *Elec. Mchy. | | .8 | 1200 |
| 130 | Westg. | HR | 1.0 | 300 |
| 130 | *G.E. | TS-7641 | 1.0 | 514 |
| 125 | *G.E. | TS-8214 | 1.0 | 277 |
| 125 | *Elec. Mchy. | | | 900 |
| 115 | Elec. Mchy. | | 1.0 | 240 |

### SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 volts or higher)

| HP | Make | Type | Speed |
|---|---|---|---|
| 1250 | *Al-Ch. (3) | ANX | 3600 |
| 1200 | *Al-Ch. | ARW | 1200 |
| 750 | *Westg. | CS | 900 |
| 500 | *Al-Ch. | ARW | 3500 |
| 500 | Gen. Elec. | K-6345 | 1200 |
| 500 | G.E. | KT-424 | 450 |
| 350 | *G.E. | KT-559A | 1800 |
| 250 | West | CS-81208 TEFC | 1800 |
| 250 | G.E. (2) | KT-559 | 1800 |
| 250 | *L-Allis | 8EX-149 | 720 |
| 250 | *G.E. | IK | 600 |
| 250 | G.E. | IK-17A | 600 |
| 250 | Westg. | CS-14 | 514 |
| 200 | *G.E. | FT-549Y | 3600 |
| 200 | *G.E. | IK-13B | 1800 |
| 200 | G.E. | IK-16 | 1200 |
| 200 | *Al-Ch. | ANZ-TEFC | 900 |
| 200 | *Westg. | CS-930A | 900 |
| 200 | G.E. (2) | KF-584S | 720 |
| 200 | *Al-Ch. | AN | 720 |
| 200 | Westg. | CS-1010 | 600 |
| 200 | Al-Ch. | ARWWT | 600 |
| 150 | Cr. Wh. | SC-140 Vert | 3450 |
| 150 | G.E. | IE-13B | 1200 |
| 150 | *Al.Ch. | AN-30F | 1200 |
| 150 | G.E. | IK-15A | 900 |
| 150 | *Westg. | CS | 600 |
| 125 | *Westg. | CS-771 Spgf. | 1800 |
| 125 | *Al-Ch. | AR | 1800 |
| 125 | Westg. (2) | CS-761S | 1750 |
| 125 | Cr-Wh. (2) | Size 5QR | 1200 |
| 125 | G.E. | K-556 | 900 |
| 125 | Al-Ch. | AN | 514 |
| 100 | Westg. CS | 5073 TEFC | 3600 |
| 100 | *Westg. | CS-760A | 1800 |
| 100 | *G.E. | FTRP-543 | 1800 |
| 100 | Al-Ch. | ARZ-826FS | 1200 |
| 100 | *Westg. | CS-760D | 1200 |
| 100 | G.E. | KT-553 | 1200 |
| 100 | Al-Ch. | AW-23DS6 | 1200 |
| 100 | *G.E. | KF-556 | 900 |
| 75 | G.E. (2) | FT-529Y | 3600 |
| 75 | Al-Ch. (3) | AR-445S | 3600 |
| 75 | G.E. | KG-445 | 1800 |
| 75 | G.E. | KT-537 | 1800 |
| 75 | *Al-Ch. | AR505S | 1725 |
| 75 | G.E. | KT-546S | 1200 |
| 75 | *G.E. | KF-542 | 1200 |
| 75 | Westg. | CS-664C | 1200 |
| 75 | Al-Ch. | APZ-503 | 1200 |
| 75 | G.E. | KT-342 | 1200 |

### MOTORS DIRECT CURRENT

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 250 | Westg. | SK-220 | 450/600 |
| 200 | Rel. (2) | 1400T | 850/1200 |
| 200 | Westg. | SK-201 | 850 |
| 200 | Cr.-Wh. | CM | 900 |
| 175 | G.E. | ETC | 750 |
| 100 | G.E. | MPC | 600/800 |
| 100 | G.E. | RC-34 | 2500 |
| 100 | G.E. | RC-19 | 575 |
| 100/150 | G.E. | MCF | 380/1000 |
| 50 | Cr.-Wh. | CMC | 700/1100 |
| 35 | West (2) | SK-150 | 350/1000 |
| 30 | Cr.W. | CCM-504 | 450 |
| 30/40 | G.E. (2) | CD-125 | 400/1800 |
| 30/40 | G.E. | CD-115 | 500/1500 |
| 25/30 | G.E. (2) | RF-12 | 500/1500 |
| 25 | G.E. | RC-32 | 800 |
| 25 | Westg. | SK-135 | 575 |
| 20/25 | Westg. | SK-151L | 250/1000 |
| 20 | Star | SB | 1750 |
| 15 | Westg. | SK-103 | 400/1600 |
| 10/15 | Reliance | 185T | 400/1800 |
| 10/15 | Westg. | SK-121 | 250/1000 |

### MOTOR-GENERATOR SETS

| KW | Make | A.C. | D.C. |
|---|---|---|---|
| 1250 | Westg. | 6600/4160 | 600 |
| 1000 | G.E. | 12000 | 600 |
| 500 | G.E. | 4160/2300 | 250 |
| 400 | A.C. | 2300 | 120/240 |
| 300 | G.E. | 440 | 250 |
| 250 | G.E. | 440 | 250 |
| 200 | G.E. | 2300 | 250/275 |
| 200 | Westg. | 2300/4000 | 250/275 |
| 200 | Ridgeway | 2300 | 250 |
| 170 | G.E. | 440 | 125 |
| 150 | G.E. | 2300 | 125/250 |
| 150 | A.C. | 2300 | 275 |
| 150 | Westg. | 2300 | 125/250 |
| 150 | G.E. | 440 | 275 |
| 125 | Cr-Wh. (3) | 4160 | 125 |
| 100 | G.E. | 2300 | 250 |
| 100 | Al-Ch. | 2300 | 250 |
| 100 | Elec.-Mach. | 440 | 125 |
| 100 | G.E. | 440 | 125 |
| 90 | G.E. | 220/440 | 125 |
| 75 | G.E. | 440 | 125 |
| 50 | Reliance | 440 | 250 |
| 50 | Ideal | 2300 | 250 |
| 50 | Westg. | 220/440 | 250 |
| 50 | Westg. | 240 | 125 |
| 50 | G.E. | 440 | 125 |
| 40 | G.E. | 440 | 125 |
| 25 | Westg. | 220 | 275 |
| 20 | G.E. | 440 | 250 |
| 20 | Bogue-G.E. | 440 | 125 |
| 20 | G.E. | 220/440 | 250 |
| 15 | Westg. | 220/440 | 250 |
| 15 | Ideal | 440 | 125 |

### DYNAMOMETERS

| HP | Make | Type | Speed |
|---|---|---|---|
| 125 | G.E. Cr. | TLC-20 | 2700/6000 |
| 150 | G.E. 3 Cr. | TLC-50 | 2500/5000 |
| 200 | Westg.-Sk. | SK-151 | 1350/4000 |

### PLATERS

| AMP | MAKE | VOLTS |
|---|---|---|
| 7500/3750 | Elec. Prod. | 6/12-220/440 |
| 7500/3750 | Chandy. | 12/24-220/440 |
| 6000/3000 | Chandy. | 12/24-220/440 |
| 2000/1000 | Chandy. | 6/12-220/440 |
| 1500/750 | Chandy. | 12/24-220/440 |
| 1500/750 | Chandy. | 6/12-220/440 |
| 1000/500 | Chandy. | 12/24-220/440 |

### TRANSFORMERS

| KVA | MAKE | TYPE | VOLT |
|---|---|---|---|
| 1000 | G.E. (3) | Oil | 13200-2300 |
| 1000 | Wagner (3) | Oil | 13800-240/480 |
| 833 | G.E. (3) | Oil | 13800-480 |
| 667 | Al. Ch. (3) | Oil | 34500-2400/4160Y |
| 677 | G.E. new (1) | Oil | 33000-480 |
| 500 | G.E. (3) | Oil | 13800-480/238 |
| 333 | Al-Ch. (3) | Oil | 13200-2400 |
| 250 | Westg. (3) | Oil | 2400/4160-480/240 |
| 150 | Chg. El. (3) | Air | 2300-110/220 |
| 100 | Al. Ch. (3) | Oil | 2400-240/480 |
| 100 | Jeff. (3) | Air | 2400-220/110 |
| 100 | Maloney (2) | Oil | 2300-220/110 |
| 100 | G.E. (2) | Oil | 2300-115 |
| 100 | G.E. (1) | Oil | 2400-120/240 |
| 100 | Pitts. (3) | Oil | 2400-575 |
| 100 | Pitts. (1) | Oil | 2400-120/240 |
| 75 | G.E. (3) | Oil | 2400-120/208 |
| 50 | West. (3) | Oil | 7200/12470-120/240 |
| 50 | West. (2) | Oil | 2300/1150-115 |

*First Source for 47 Years for Quality Electrical Equipment*

## CHICAGO *Electric Co.*

**1320 W. CERMAK RD. CAnal 6-2900 CHICAGO 8, ILL.**

## POWER PLANT EQUIPMENT

***SPECIAL OFFERINGS***

### TURBO-GENERATORS

1—7500 KW 2400/4160 volt Condensing—400#—700° FTT. New 1949

1—3500 KW 2400/4160 volt Condensing—400#—700° FTT. New 1941

1—1000 KW—240/480 volts—130/250# Cond. Auto. Extraction—15#—New 1945

1—1000 KW 480 volts—225# Condensing Auto. Extraction—20#

1—1250 KW 480 volts N. Cond. 150#—15# S.P.

1—300 KW — 480 volts — 210# Condensing Auto. Extraction—40#

1—250 KW—240 volts—130#—Non-Cond. 10/12# Back pressure

### TRANSFORMERS

1—500 KVA 4160/480 V. Pyrenol. 3 ph.

3—1667 KRH—13800/600 volts New 1948

**A. LEE ELLIS CO., U.S. Machy. Bldg., 140 Federal St., Boston 10, Mass.**

*THE BUYERS MUST BE SATISFIED—ALWAYS*

## look for the WAGNER GREEN TAG CERTIFICATION

It's your guarantee that the equipment you buy is as perfect in workmanship as the day it left the factory.

### D. C. MOTORS

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 300 | G.E. dynamom. | TLC | 250 | 1150/1500 |
| 200 | G.E. | RC-29 | 500 | 875 |
| 170 | Cr. Wh. | 151-H | 230 | 500 |
| 150 | Whse. | SK-184 | 230 | 850 |
| 100 | Reliance | 651-T | 550 | 1000/1600 |
| 100 | Elliott b.b. T.E. | JH-FE | 230 | 1150 |
| 75 | Reliance (3) | 985-T | 230 | 450/1200 |
| 60 | G.E. TEFC b.b. | CD-135 | 230 | 1150 |
| 50 | Century | DN-514 | 230 | 1150/1750 |
| 50 | Gen. Elec. | CD-95 | 230 | 1800 |
| 50 | Star b.b. | SQ-92 | 230 | 680 |
| 50 | G.E. | CD-125 | 230 | 400/1200 |
| 50 | G.E. | RF-16 | 230 | 250/1000 |
| 40 | G.E. (2) | CD-93 | 230 | 1750 |
| 30 | Whse. (2) | SK-151 | 230 | 250/1000 |

### MOTOR-GENERATOR SETS

| KW | Mfr. | Input V | Output V |
|---|---|---|---|
| 600 | Allis Ch. | 2200 AC | 250 DC |
| 250 | Cr. Wh.* | 440 AC | 250 DC |
| 200 | Whse.* | 220/440 AC | 55 DC |
| 200 | Gen. Elec.* | 220/440 AC | 125 DC |
| 200 | Whse. | 2300 AC | 250 DC |
| 175 | Gen. Elec. | 220/440 AC | 250 DC |
| 125 | Gen. Elec.* | 2300/4000 AC | 250 DC |
| 100 | Gen. Elec.*(2) | 220/440 AC | 250 DC |
| 75 | G.E. converter | 440 AC | 250 DC |
| 75 | G.E. | 220/440 AC | 125 DC |
| 60 | Whse. | 220/440 AC | 250 DC |
| 50 | Gen. Elec. | 220/440 AC | 125 DC |
| 50 | Cr. Wh. b.b. (2) | 220/440 AC | 250 DC |
| 30 | G.E. | 220/440 AC | 125 DC |

### D. C. GENERATORS

| KW | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 200 | G.E. | RC | 600 | 1150 |
| 150 | Whse. | SK-184 | 250 | 1150 |
| 150 | Cr. Wh. | CCD | 250 | 650 |
| 100 | Delco b.b. | | 240 | 1200 |
| 100 | Allis Ch. | E | 125 | 1200 |
| 100 | Reliance | 651-T | 600 | 1200 |
| 75 | Gen. Elec. | CD-123 | 125/250 | 1200 |
| 60 | Allis Ch. (3) | E-146 | 250 | 1500 |
| 60 | Ideal | D | 125 | 1150 |
| 45 | Allis Ch. | E-123 | 250 | 1800 |

### A. C. MOTORS — 60 CYCLE

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 500 | G.E. | Sq. Cage | 4000 | 1800 |
| 500 | Whse. | Slipring | 2200 | 450 |
| 400 | Whse. (2) | Synch. | 2200 | 1800 |
| 400 | Whse. | Sq. Cage | 2200 | 514 |
| 400 | Marathon (2) | Sq. Cage | 2200 | 3600 |
| 400 | Whse. | Sq. Cage | 2300 | 900 |
| 400 | G.E. (2) | Slipring | 440 | 900 |
| 350 | G.E. | Sq. Cage | 2200 | 1800 |
| 350 | Cont. b.b. | Slipring | 2300 | 900 |
| 350 | G.E. | Slipring | 440 | 1200 |
| 350 | Allis Ch. | Slipring | 2200/4000 | 600 |
| 300 | G.E. | Slipring | 2200/440 | 600 |
| 300 | G.E. (2) | Synch. | 2200/440 | 360 |
| 300 | Whse. | Sq. Cage | 2200/440 | 720 |
| 300 | Whse. | Synch. | 440 | 1200 |
| 300 | G.E. | Slipring | 440 | 450 |
| 250 | Ideal | Slipring | 2200 | 900 |
| 250 | G.E. | Sq. Cage | 2200/440 | 1200 |
| 250 | Gen. Elec. | Sq. Cage | 440 | 3600 |
| 250 | G.E. | Slipring | 220/440 | 720 |
| 250 | Gen. Elec. | Synch. | 220/440 | 450 |
| 250 | Whse. | Slipring | 440 | 1200 |
| 250 | G.E. | Sq. Cage | 2200 | 1800 |
| 225 | G.E. | Synch. | 220/440 | 900 |
| 200 | G.E. (2) | Sq. Cage | 2200/440 | 1200 |
| 200 | Reliance b.b. | Sq. Cage | 220/440 | 1800 |
| 200 | Allis Ch. | Slipring | 440 | 450 |
| 200 | Allis Ch. | Slipring | 2200/440 | 720 |
| 200 | Cr. Wh. | Sq. Cage | 220/440 | 3600 |
| 200 | Whse. | Sq. Cage | 2200/440 | 900 |
| 200 | G.E. | Sq. Cage | 440 | 900 |
| 175 | G.E. (2) | Synch. | 220/440 | 720 |
| 150 | El. Machy. | Synch. | 220/440 | 360 |
| 150 | G.E. (4) | Slipring | 2200/440 | 600 |
| 150 | Cr. Wheeler | Sq. Cage | 220/440 | 450 |
| 150 | G.E. | Slip Ring | 220/440 | 450 |
| 150 | G.E. (2) | Sq. Cage | 2200/440 | 1800 |
| 150 | Allis Ch. b.b. | Sq. Cage | 2200/440 | 720 |
| 125 | Whse. TEFC | Sq. Cage | 2200/440 | 720 |
| 125 | G.E. TEFC | Sq. Cage | 2200 | 3600 |
| 125 | Ideal | Slipring | 4000/2200 | 900 |
| 100 | Al. Ch. TEFC | Sq. Cage | 2300/440 | 720 |

**TRANSFORMER — 300KVA Penn. dry type, 3/60/4160V. to 480V., like new.**

## THOUSANDS OF MOTORS & GENERATORS IN STOCK

AC & DC . . . all sizes and types up to 1000 H.P. . . . all covered by the WAGNER guarantee.

## Arthur Wagner Co.

Certified

MO nroe 6-7409
1435 W. RANDOLPH ST
CHICAGO 7, ILLINOIS



## 37 Years Dependable Service

### SLIP RING MOTORS 3-Ph., 60 Cy.

| H.P. | Volts | Make | Speed |
|---|---|---|---|
| 800 | 2300 | Whse. | 900 |
| 500 | 4000/2300 | G.E. | 600 |
| 450 | 440 | Whse. | 514 |
| 400(2) | 2300 | G.E. | 900 |
| 300 | 4000/2300 | G.E. | 720 |
| 300 | 2300 | G.E. | 900 |
| 300 | 440 | G.E. (hoist) | 600 |
| 300 | 440 | Whse. | 3600 |
| 250 | 2300/440 | G.E. | 1200 |
| 225 | 4000/2300 | G.E. (hoist) | 600 |
| 200 | 2300 | G.E. | 600 |
| 200 | 2200/440 | G.E. | 720 |
| 150 | 440/220 | Whse. | 720 |
| 150 | 2200/440 | G.E. | 600 |
| 125 | 2200 | G.E. | 600 |
| 100 | 440/220 | G.E. | 720 |

### SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

| H.P. | Volts | Make | Type | R.P.M. |
|---|---|---|---|---|
| 400 | 2300/440 | G.E. | ATI | 720 |
| 375 | 2200 | Whse. | G | 900 |
| 350 | 440/220 | El. Machy. | Syn. | 1200 |
| 300 | 2300/440 | G.E. | TS | 720 |
| 300 | 2200/440 | G.E. | TS | 1200 |
| 250 | 440/220 | G.E. | ATI | 600 |
| 150 | 440/220 | G.E. | TS | 720 |
| 125 | 440/220 | Whse. | HR | 400 |

### SQUIRREL CAGE MOTORS

| H.P. | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 600 | 2200 | G.E. | FT | 3600 |
| 500 | 2200/4000 | Elliott | SC | 1800 |
| 350 | 2300 | G.E. | IM | 600 |
| 350 | 440 | G.E. | KT | 1200 |
| 300(2) | 2200 | G.E. | FT | 3600 |
| 300 | 2300/4000 | L. Allis | FS | 1800 |
| 250 | 440/220 | G.E. | KT | 720 |
| 250 | 2300 | Whse. | CS | 600 |
| 200 | 440/220 | G.E. | KT | 1800 |
| 200 | 2200 | G.E. | KT | 1800 |
| 150 | 2200 | Al. Chal. | AR | 1800 |
| 150 | 440/220 | G.E. | KT | 720 |
| 150 | 2200/440 | | KT | 600 |
| 150 | 2200/440 | G.E. | FT | 1200 |
| 125(3) | 2300/440 | Whse. | X-proof | 720 |
| 125 | 2300/440 | G.E. | K | 900 |
| 100(3) | 4000/2300 | L. Allis | OX | 1200 |

### A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—360 kva, 900 rpm, 2200 V., Whse.
1—225 kva, 60 rpm, 220/440 V., G.E.
1—187 kva., 1200 rpm, 2200/440 V., Whse.

### CIRCUIT BREAKERS

2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V, G.E.
1—400 Amp., Condit, 3P, 25 KV outdoor
1—400 Amp. R. Smith, 3P 7.5 KV outdoor

### D. C. MOTORS

| H.P. | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 225 | 230 | Whse. | SK | 1800 |
| 200 | 230 | Cr. Wh. | CMC | 1200 |
| 150 | 230 | El. Dyn. | B/brg. | 600 |
| 125 | 230 | G.E. | CD | 850 |

### MOTOR GENERATOR SETS

| KW | Make | Input V., AC | Motor Type | Output V., DC |
|---|---|---|---|---|
| 250 | Whse. | 2200 | Syn. | 250 |
| 150 | Whse. | 440/220 | Sq. Ca. | 275 |
| 125 | G.E. | 4000/440 | Syn. | 125 |
| 100 | G.E. | 2200/440 | Syn. | 250 |
| 75 | Cr. Wh. | 440/220 | Sq. Ca. | 240/130 |
| 65 | G.E. | 2300/440 | Sq. Ca. | 250 |
| 125 | G.E. | 440 | Sq. Ca. | 250/125 |

### TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1— 600 kva, Standard, 13,800—2300 V., 3 ph.
3— 500 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 13,800—2300 V.
2— 300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3— 200 kva, Mol., 13,800—2300 V.
3— 150 kva, Al. Ch. 2400—220 V.
3— 150 kva, Al. Ch. 440-220 V., dry, New
3— 100 kva, G.E., 2400—240/480, V New
3— 333 kva, G.E., 13,200—480 V.
3— 150 kva, G.E., 13,200—2300 V.
3— 100 kva, G.E., 2400—120/240 V., Pyr.

*only partial listing*

STEPHEN **HALL** & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.



### MODERN POWER PLANT

1875 KVA WORTHINGTON MOORE TURBINE 400 PSI, 700°F Condensing, driving 2300 Volt CROCKER WHEELER GENERATOR 25000#/Hr. 450 PSI, 738°F, Coal Fired BOILER; includes all auxiliaries, controls, 25 Ton powerhouse crane and coal handling facilities.

### 3 PPM VAPOR EVAPORATOR

GRAHAM 8700 to 15,000 lbs./hr. complete with all auxiliaries. New 1954.

### 80000#/HR. BOILER

ERIE CITY Type 1-W-T BENT WATER TUBE 3 drum 250 PSI W.P.; Built 1948; 8100 sq. ft. heating surface; 1370 sq. ft. water wall surface; steel encased; Rotograte spreader stoker; forced and induced draft fans; dust collectors; Thermix stack. Used only 2 years.

### 75000#/HR. BOILER

COMBUSTION ENGR. CO. 4 drum STIRLING Type BOILER 400 PSI W.P.; pulverized coal fired; forced and induced draft fans; superheater, waterwalls.

### 400 HP BOILER (2)

B&W (Stirling) 160 PSI Oil & Gas fired ASME, New 1947.

### SYNCHRONOUS MOTOR

700 HP, 4150/2400V, 514 RPM.

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Murray Hill 7-5280
*(Machinery & Equipment Merchants)*



## NEW STEAM JET AIR EVACTORS

Several in stock, large range in sizes, capacities from 1000 KW to 10,000 KW. Priced right.

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Detroit 35, Michigan
Phone: BRoadway 3-1901



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1—12" x 36" 122 R.P.M. Greenwald-Brown engine direct connected to 150 K.W. D.C. 250 V. 600 Amp. Thresher generator.

1—1200 lb. per hour—48 sq. ft. grate area, Detroit underfeed stoker, complete with 5" x 5" Clarage steam engine drive and fan. A-1 condition.

5—Diamond valve in head soot blowers complete with high temperature elements.

1—Republic 300 degree to 800 degree F. Stack temperature thermometer.

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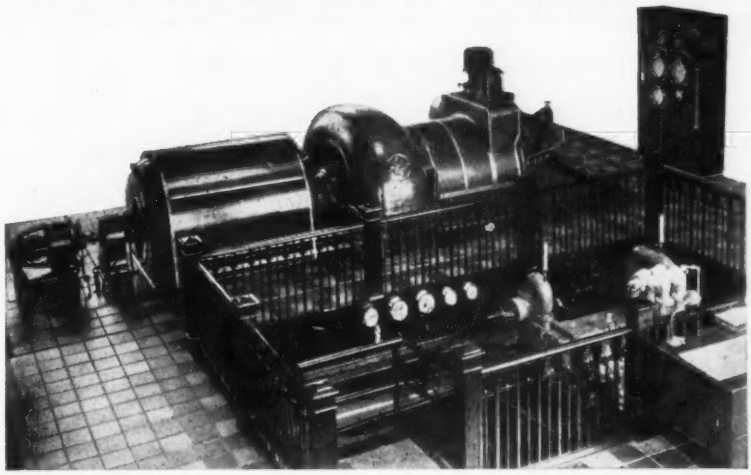
2000 KW, 80% P.F.—2500 KVA, General Electric, Type ATB, Form HT, 3 phase 60 cycle, 2300 volt, 3600 RPM, 2 bearing alternating current generator suitable for operation as synchronous condenser.

EUCLID ENGINEERING CORPORATION
National City East Sixth Building
Cleveland 14, Ohio

## MODERN 400 LB., 750 DEG. TURBINE-GENERATOR



THE ABOVE 3750 KVA GENERAL ELECTRIC IS IN VERY GOOD CONDITION TURBINE #43103 GENERATOR #5406647 DIRECTLY CONNECTED EXCITER. COMPLETE WITH SURFACE CONDENSER, SWITCHBOARD, AND ALL AUXILIARIES.

***ALSO IN STOCK***

1—12,500 KW 350#, 600 DEG., 13,200V
1—10,000 KW 600#, 750 DEG., 12,000/13,200V
1— 2,500 KW 250/400# 13,800V, Automatic Ext. 50#

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**COMPLETE POWER PLANT & AUXILIARIES**

2—1500 KW Turbo-generators—1 New 1948 400#
1000 KW Turbo-generator unit.
B&W Boiler, 4500#/hr @ 450#—New 1951
B&W Boiler, 27500# hr @ 450#—New 1948

**OTHER EQUIPMENT FOR SALE**

60—35# Cane Pulling Compound, Gulf
3—500 KVA Transformers, 1/60, 13800-2400/4160 New
3—1250 KVA Transformers, 1/60, 44000-2400/4160

**TRANSFORMERS WANTED**

1000 KVA Capacity, 44000-7200/12470Y
4500 KVA Capacity, 7620/13200-2400/4160Y
7500 KVA Capacity, 6900 Delta—14400/24900-6900GY

Several hundred modern transformers for sale rated from 1½ to 20000 KVA. Write for free copy of our listings.

**CONTINENTAL CORPORATION**

**790 Fulton St.** **Denver 8, Colorado**

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## TRANSFORMERS

3—500 KVA, 1/60/2300-4000Y to 230/460 Westinghouse OISC, with taps
3—833 KVA, 1/60/34500/460 Moloney OISC, with taps
3—677 KVA, 1/60/33000/460 Moloney, OISC, Type CR
1—300 KVA, 3/60/4160-240 Wagner, type HPB-ITE Unit Substation
1—200 KVA, 3/60/4160-240, Wagner, Type RPB-ITE Unit Substation

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**GENERATORS—GAS OR DIESEL**
**USED & REBUILT EQUIPMENT**
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**217 Colden St., Jersey City, N. J.**
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***"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed New and Rebuilt Motors"***

**SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT**

| HP | Make | Type | Speed |
|---|---|---|---|
| 300 | F.M. B.B. Open | H | 1800 |
| 300 | G.E. S.B. Open | IK | 1800 |
| 300 | A.C. S.B. Open | AR-630 | 1800 |
| 300 | G.E. S.B. Open | IK | 900 |
| 300 | G.E. S.B. Open | IK | 720 |
| 250 | G.E. TEBB, 2300 V | K | 1800 |
| 250 | G.E. S.B. Open | KT | 1800 |
| 250 | F.M. B. Open | H | 1800 |
| 250 | G.E. S.B. Open 2200 v | IK-16 | 1200 |
| 250 | G.E. S.B. Open | IK | 1200 |
| 250 | G.E. S.B. Open | IK | 900 |
| 250 | G.E. S.B. Open | IK | 720 |
| 200 | G.E. TEBB | K | 1800 |
| 200 | A.C. S.B. Open | ARW-626 | 1800 |
| 200 | G.E. S.B. Open | KT-559 | 1800 |
| 200 | G.E. S.B. Open | IK-15 | 1200 |
| 200 | West. SSB Open | CS-873C | 1200 |
| 200 | G.E. S.B. Open | IK-158 | 1200 |
| 200 | G.E. S.B. Open | KT-562 | 1200 |
| 200 | G.E. S.B. Open 2200V | IK | 1200 |
| 200 | West. SSB Open | CS-870C | 900 |
| 200 | G.E. S.B. Open | IK | 900 |
| 200 | G.E. S.B. Open | IK | 720 |
| 200 | G.E. S.B. Open | IK | 600 |
| 200 | West. SB Open | CS-1002 | 600 |
| 150 | G.E. TEFCBB | K-6328 | 3600 |
| 150 | G.E. TEFCBB XP | K | 3600 |
| 150 | G.E. TEBB | K | 1800 |
| 150 | West. S.B. Open 2200 V | CS | 1800 |
| 150 | G.E. S.B. Open | IK | 1800 |
| 150 | West. S.S.B. Open | CS-773C | 1200 |
| 150 | G.E. S.B. Open | IK | 1200 |
| 150 | G.E. S.B. Open | KT-558 | 900 |
| 150 | G.E. S.B. Open | IK | 720 |
| 150 | Howell BB Open | | 720 |
| 150 | G.E. S.B. Open | IK | 600 |
| 150 | West. SB Open 2200 Volt | CS | 600 |
| 125 | G.E. TEFCBB | K | 3600 |
| 125 | A.C. BB Open | AR-505 | 1800 |
| 125 | L.A. T.E.F.C. BB 440 V | JX | 1800 |
| 125 | West. S.S.B. Open New | CS-607 | 1800 |
| 125 | G.E. S.B. Open | IK | 1800 |
| 125 | West. S.B. Open | CS | 1800 |
| 125 | West. S.S.B. Open 2200 V | CS-607 | 1800 |
| 125 | G.E. S.B. Open | KT-553 | 1200 |
| 125 | G.E. S.B. Open | IK | 1200 |
| 125 | West. SSB Open | CS-764C | 1200 |
| 125 | G.E. S.B. Open | IK | 900 |
| 125 | G.E. S.B. Open | IK | 720 |
| 125 | G.E. S.B. Open | IK | 600 |
| 125 | A.C. BB Open | AR | 600 |
| 100 | A.C. S.B. Open | AR-505S | 3600 |
| 100 | F.M. B.B. Open | H-121D | 1800 |
| 100 | G.E. S.B. Open | KT-343 | 1800 |
| 100 | Burke B.B. Open | N-505 | 1800 |
| 100 | A.C. S.B. Open 2200 V | ARX | 1800 |
| 100 | Century S.B. Open | SC-505 | 1800 |
| 100 | A.C. BB Open | AR-505 | 1800 |
| 100 | West. SSB Open | CS-607 | 1200 |
| 100 | West. SSB Open | CS | 1200 |
| 100 | A.C. SB Open 2200 Volt | ARX | 1800 |
| 100 | F.M. BB Open | QSZ-505 | 1800 |
| 100 | A.C. TEFCBB | ARZ | 1200 |
| 100 | West. S.S.B. Open | CS-607 | 1200 |

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NEW & USED Electrical Equipment

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Large line of motors, Control Equipment, AC and DC Generators, MG sets and transformers. PHONE or WIRE us COLLECT

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# HIGH PRESSURE TURBINE-GENERATORS

## *IMMEDIATELY AVAILABLE*

1—12,500 KW 350# 600 Deg FTT, 13,800 V

1—10,000 KW at 70% P.F., 600 PSIG, 750 Deg. FTT, 12,000/13,200 V. Installed 1947.

1—2500 KW 80% P.F. 250/400# Aut. Ext. 50# Condensing, 3/60/13800.

1—3000 K.W. 400# Condensing, 3/60/2300/4160.

Complete with Surface Condensers and all Auxiliaries.

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**Telephone: Broadway 3-1901**

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### USED HEAT EXCHANGERS

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|---|---|
| Ross — #1920 | 670 Sq. Ft. |
| Ross — #2520 | 1257 Sq. Ft. |
| GR—Size 25-8-240 | 1280 Sq. Ft. |
| Alco—Size 27-192 | 1320 Sq. Ft. |
| Whitlock | 2400 Sq. Ft. |

### FORCED DRAFT FANS

Sturdevant (NEW) 52000 CFM, Size 30½ with 200 H.P. Geared Turbine Drive. Westinghouse (USED) 21000 CFM, with 72 H.P. Turbine Drive.

### SPECIAL

New Surface Condensers
Worthington 11,000 Sq. Ft.

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|---|---|
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| C. H. Wheeler | 436 Sq. Ft. |
| Foster-Wheeler | 580 Sq. Ft. |
| C. H. Wheeler | 725 Sq. Ft. |
| N. Y. Shipbuilding | 2000 Sq. Ft. |

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Struthers-Wells — 206 Sq. Ft.
(60,000#/Hour, 6-Pass.)

### NEW LUBE OIL COOLERS

| | |
|---|---|
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| Alco #10-54 | ( 75 Sq. Ft.) |
| Struthers Wells | (186 Sq. Ft.) |

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**65 MUIRHEAD AVENUE, TRENTON, N. J.**

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1902-1957

WORLD'S BEST REBUILTS

| | | |
|---|---|---|
| 66 CFM | 125 psi | 5 x 9 Ing.—ESI St. Booster |
| 138 CFM | 100 psi | 7x7 Ing—ESI |
| 184 CFM | 135 psi | 8x9 Chic—T |
| 234 CFM | 100 psi | 9x9 Ing. ESI |
| 268 CFM | 500 psi | 10—4¼x10 Ing. XOB |
| 368 CFM | 100 psi | 12x10 IR-CP—Penn |
| 420 CFM | 40 psi | 12x9 Ing. ES—Oil-Less |
| 465 CFM | 100 psi | 12x11 Penn 3AT Gardner X |
| 528 CFM | 100 psi | 14x12 IR-CP—Penn |
| 585 CFM | 100 psi | 15—6½x12 IR—XRE 3-60-440 |
| 669 CFM | 50 psi | 15x11 Worth. HB or HS |
| 676 CFM | 100 psi | 15—6½x12 Ing. XRB |
| 1050 CFM | 100 psi | 18—11x14 Ing. XCB |
| 1050 CFM | 100 psi | 18—11x12 Penn DEZ 3-60-2300 |
| 1385 CFM | 100 psi | 13—8x7 Joy WNI14—3-60-440 |
| 1721 CFM | 100 psi | 23—14x16 Ing. PRE2 3-60-2300 |
| 2900 CFM | 100 psi | 29—18x1 Ing. PRE2 3-60-2300 |
| 3480 CFM | 100 psi | 23—13x18 CP OCTDE 3-60-2300 |
| 5748 CFM | 50 psi | 29—29x21 Ing. PREI 3-60-2300 |

PORTABLES—60-600 CFM Rotary or reciprocating

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## DIESEL GENERATOR SETS

2—McIntosh-Seymour (Alco) 950 HP 8 cyl. 225 RPM, 875 KVA Westinghouse 3 phase, 25 or 60 cycle alternators, 20 KW exciters.

1—Baldwin DeLavergne 1140 HP 6 cyl. 4 cycle, 200 RPM, 1000 KVA Elliott 3/60/2400 generator. 20 KW exciter

*Complete plant installation with all accessories. Priced attractively.*

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## TURBO-GENERATOR

7500 KW Whse. Cond. 3/60/2400 V.
3600 RPM 400 PSIG 700°
2500 KW Whse. Cond. 3/60/2400 V.
3600 RPM 400 PSIG 750°
2000 KW Al.Ch. Cond. 3/60/600 V.
3600 RPM 400 PSIG 720°
1500 KW Ell. Cond. 3/60/2400/4150 V.
3600 RPM 400 PSIG 750°
300 KW G.E. Non-C. 3/60/480 V.
3600 RPM 150 PSIG 5#BP

*Full line power equipment*

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200 HP Comb.-Engr. Type M-2, 275 psi, Heavy Oil Fired, 1952 Models, excellent condition, used only on 100 psi

Reasonably priced for immediate sale

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100 KW to 1500 KW

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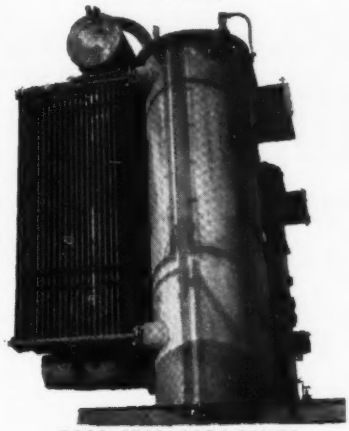

## 3000 KVA MOLONEY TRANSFORMER

**3 phase, 60 cycle, Type TCR**

3000 KVA continuous, 55°C. rise self cooled.
3650 KVA continuous, 50°C. rise, forced air cooled.
7200 volt primary with 4—2½% taps below.
Low voltage 4160 Y/2400 volts, oil cooled.

IMMEDIATELY AVAILABLE

# Rebuilt HEMPHILL Guaranteed EQUIPMENT

### TRANSFORMERS—60 CYCLE

| Qu | KVA | Make | Type | Phase | Voltages |
|---|---|---|---|---|---|
| 2 | 750 | G.E. | H | 1 | 4600-120/240 |
| 1 | 750 | G.E. | HT | 3 | 4150Y-220/440 |
| 2 | 250 | G.E. | H Pyranol | 1 | 2400-4800-8320Y-120/240 |
| 2 | 250 | West. | | 1 | 2300/4600-230/460 |
| 3 | 200 | G.E. | H | 1 | 7800/15600-220/440 |
| 1 | 150 | Elsler | OA | 1 | 4160-240/480 |
| 2 | 3000 | Maloney | TCR | 3 | 7200/6600-4160/2400 |
| 2 | 37½ | West. | Hyperail | 1 | 2400/4160-240/480 |
| 4 | 25 | West. | Hiperiol | 1 | 2400/4160-120/240 |
| 3 | 15 | West. | H Pyranol | 1 | 6900/11950Y-120/240 |
| 6 | 15 | Maloney | KL | 1 | 2400/4160Y-120/240 |
| 1 | 50 | Amer. | Abestol | 3 | 4160-120/208Y |

### SYNCHRONOUS MOTORS

| Qu | HP | Make | Speed | Type | Volts |
|---|---|---|---|---|---|
| 1 | 100 | G.E. | 900 | TS | 2300 |
| 1 | 125 | G.E. | 600 | TS | 2300 |
| 1 | 125 | E.M. | 900 | | 4800 |
| 1 | 150 | G.E. | 1800 | TS | 220/440 |
| 2 | 150 | Allis-Ch. | 360 | | 2200 |
| 1 | 150 | West. | 900 | | 220 |
| 1 | 300 | E.M. | 720 | TEFC | 2300 |
| 1 | 500 | West. | 450 | HR | 440 |
| 1 | 1000 | West. | 360 | Mill | 2300/4150 |

### SLIP RING MOTORS

| Qu | HP | Make | Speed | Type | Volts |
|---|---|---|---|---|---|
| 1 | 15 | G.E. | 900 | MT-542 | 440 |
| 1 | 25 | G.E. | 900 | MT-526 | 440 |
| 1 | 60 | G.E. | 1800 | MT | 220 |
| 1 | 60 | Ideal | 900 | AY | 220 |
| 1 | 75 | G.E. | 600 | TM | 440 |
| 3 | 150 | Allis-Ch. | 1800 | AY RW | 2300 |
| 1 | 200 | West. | 514 | CW | 440 |
| 1 | 250 | West. | 600 | CW | 440 |
| 1 | 350 | West. | 1800 | CW | 2300 |
| 1 | 100 | West. | 1800 | T.E.F.C. B.B. | 220 |

### SQUIRREL CAGE

| Qu | HP | Make | Speed | Type | Volts |
|---|---|---|---|---|---|
| 1 | 25 | G.E. | 1170 | 405TEFC | 220/440 |
| 1 | 40 | Wagner | 1750 | CPI-444 TEFC B.B. | 440 |
| 2 | 75 | West. | 1180 | CS-607 | 440 |
| 1 | 100 | G. E. | 1775 | KTP-543 | 440 |
| 1 | 40 | Wagner | 1200 | CPI-445 TEFC B.B. | 440 |
| 1 | 150 | G.E. | 720 | KT-562 | 440 |
| 2 | 250 | G.E. | 1790 | K.T.E.F.C. | 2300 |
| 1 | 275 | G.E. | 1200 | KT559B8 | 2200 |
| 1 | 300 | G.E. | 1806 | K-4150V | new |
| 1 | 400 | Cont. | 1200 | N806S | 2300 |

### MOTOR GENERATOR SETS

| Qu | K.W. | Make | Speed | Volts DC | AC |
|---|---|---|---|---|---|
| 1 | 10 | G.E. | 1800 | 125 | 220/440 A.C. |
| 3 | 60 | E.M. | 1200 | 125 | 220 v. Syn. |
| 1 | 150 | Cr. Wh. | 600 | 125 | 220/440 |
| 1 | 175 | West. | 1200 | 125 | 4150 Syn. |
| 1 | 300 | G.E. | 1200 | 250 | 2300/4160Y B.B. |
| 1 | 1000 | West. | 720 | 600 | 2300/4160Y |

### D.C. 230 VOLT MOTORS

| Qu | HP | Make | Speed | Type |
|---|---|---|---|---|
| 1 | 75 | C.W. | 900 | WP T.E.F.C |
| 1 | 125 | G.E. | 1700 | RC |
| 2 | 150 | C.W. | 900 | WP T.E.F.C |
| 1 | 250 | Allis Ch. | 1750 | FBL149BB |

### A.C. HOIST MOTORS

| Qu | HP | Make | Type | Speed | Volts |
|---|---|---|---|---|---|
| 1 | 35 | G.E. | MTC | 565 | 440 |
| 2 | 300 | G.E. | ITC-5017 | 600 | 440 |

FOR POWER
**J.L. HEMPHILL & CO.**
1633 54th STREET, NORTH BERGEN, N. J.

## FOR SALE
## 18 NEW TURBINES

**4 horizontal, 14 vertical, Westinghouse**

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.
Will sell turbines separately if desired. *Price reasonable.*
*Also*—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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2457 WOODWARD AVE.
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DETROIT 1, MICH.

## WANTED

Complete power plants, turbo generators, Boilers, Condensers, Engine generators, Processing Plants and equipment.

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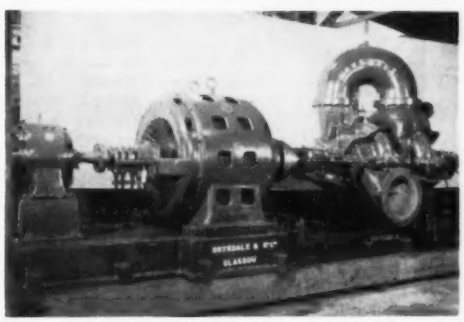
## WANTED

300 K.W. non-condensing or condensing extraction 12-15 lb. B.P. Turbo-Generator 200 PSIG 525°F T T Steam. 600 Volt 60 Cycle 3 Phase .80 P.F. generator.

**WAMESIT POWER CO.**
LOWELL, MASS.

## TWO DRYSDALE ELECTRICALLY DRIVEN TWO STAGE H/L CENTRIFUGAL PUMPS 20" SUCTION 18" DISCHARGE



Each unit:—10,000 gallons per minute 271 ft. Head, externally controlled cutwater mechanism, Wellman Bibby Flexible Coupling. 850 BHP, 2200 volt, 3 phase, 60 cycle, 900 RPM motor, all on heavy base. These are modern units completely rebuilt, suitable for irrigation or municipal waterworks.

## GENERAL MACHINERY LIMITED
GRANVILLE ISLAND VANCOUVER, B. C.

## GET CASH NOW

for your new surplus motors, controls and transformers!

**NEW MOTORS AVAILABLE:**
Over 5,000 new motors, in stock, from ¼HP to 200 HP.
Special low prices.
*Write, wire or phone collect!*

**AJAX** ELECTRIC MOTOR CORP.
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Long Distance Phone LD. 132

## —TRANSFORMERS—

### BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

**THE ELECTRIC SERVICE CO., INC.**
5318 Hetzel St. Cincinnati 27, Ohio
*45 Years' Dependable Service*

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**This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.**


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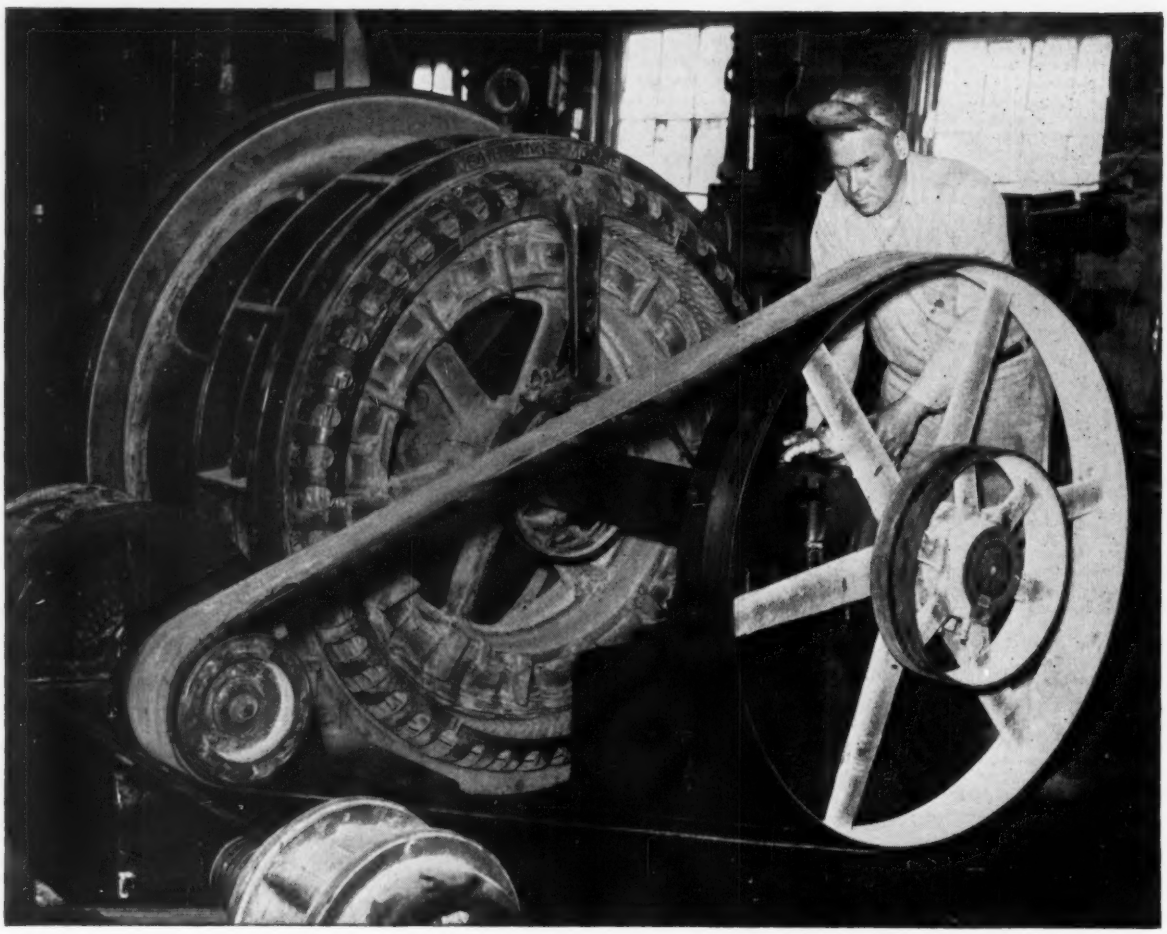


# They wanted a belt that wouldn't stretch

*B. F. Goodrich improvements in rubber brought extra savings*

***Problem:*** This is where they make the power to run all the equipment in a sand and gravel plant. There used to be a leather belt on the generator, but it stretched so badly it had to be removed and shortened again and again.

***What was done:*** Then a B.F.Goodrich man got them to try a B.F.Goodrich "Highflex" belt—an improved design that has practically no stretch, better resistance to shock loads. The special rubber compound used in the belt can stand constant flexing, makes "Highflex" a more flexible, longer-lasting belt.

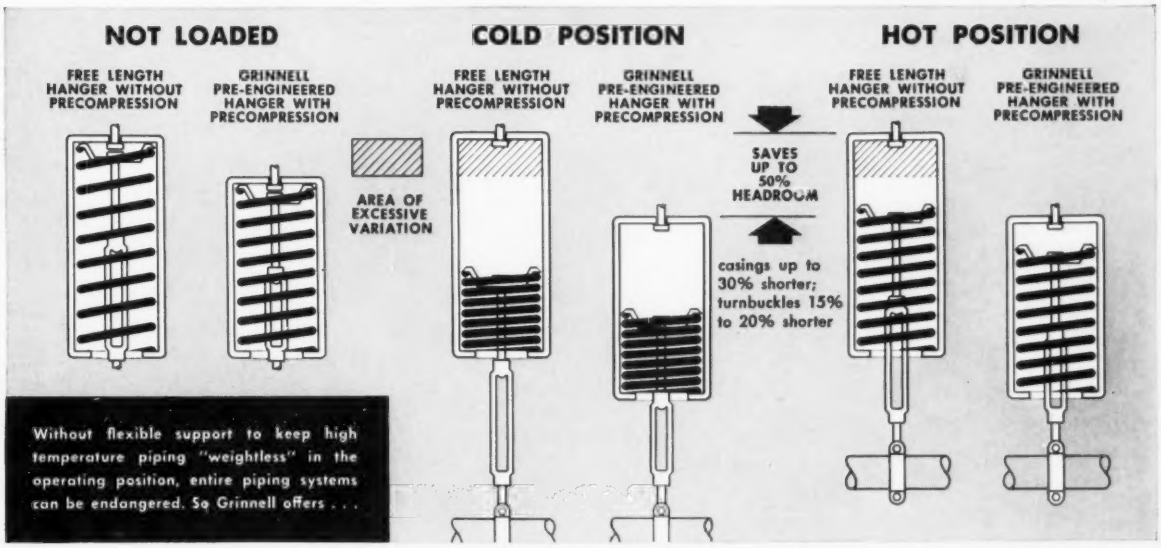
***Savings:*** The B.F.Goodrich belt was installed, and lasted nearly five years, running 10 hours a day, 6 days a week, 9 months every year. No repairs were needed, not a minute was lost in shutdowns.

***Extra benefits:*** This B.F.Goodrich belt, joined by the Plylock belt splice, eliminates the need for belt fasteners. Without the use of metal fasteners, laces or stitching, the Plylock belt joint produces a long-lasting, flexible splice practically as strong as the belt itself. Because 9 out of 10 belt failures are caused by metal fasteners working out, the Plylock splice often *triples belt life.*

*Where to buy:* Your B.F.Goodrich distributor has full information on the transmission belt described here. And, as a factory-trained specialist in rubber products, he *can* answer your questions about *all* rubber products B. F. Goodrich makes for industry. *B. F. Goodrich Industrial Products Co., Dept. M-120, Akron 18, Ohio.*

**B.F.Goodrich**

**INDUSTRIAL PRODUCTS**


NOT LOADED
COLD POSITION
HOT POSITION
FREE LENGTH HANGER WITHOUT PRECOMPRESSION
GRINNELL PRE-ENGINEERED HANGER WITH PRECOMPRESSION
AREA OF EXCESSIVE VARIATION
SAVES UP TO 50% HEADROOM
casings up to 30% shorter; turnbuckles 15% to 20% shorter
Without flexible support to keep high temperature piping "weightless" in the operating position, entire piping systems can be endangered. So Grinnell offers . . .

# Precompressed Hangers for Safer Support of Piping

Helical coil springs are widely used in hangers for flexible support of piping which moves up or down during thermal expansion. The A.S.A. code for pressure piping requires that variable spring hangers support at least a minimum of 75% of the pipe's weight for a pipe that rises (relaxing the spring) and no more than 125% of the pipe's weight for a pipe that lowers (compressing the spring) during operation.

## Precompression patented Grinnell principle

To guard against the spring's supporting force exceeding the limits of variation, Grinnell developed and patented a variable spring hanger design. The steel casing holds the spring permanently precompressed, at the threshold of the hanger's working load range. This prevents the spring decompressing into its area of excessive variation.

## Pre-set is not a substitute

As a partial substitute for this patented precompression, some manufacturers insert a spacer between the top end of a free-length hanger casing and the spring to hold the spring's height temporarily within the working range during shipment and erection.

Another device requires the manufacturer to drill symmetrically opposite holes in the casing walls and insert a bolt to hold the spring's height within the working range. When these devices are removed from the hanger and discarded, the spring can decompress, resulting in high variability in supporting force.

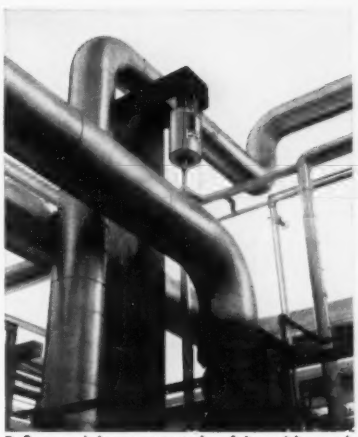
## Cold-setting a universal factory service

For the erection crew to avoid having to compress the spring down to the erected position, the manufacturer can compress the spring down to this height. Grinnell can provide a cold-set bolt in precompressed hangers.

## Less headroom required by Grinnell Hangers

Shorter hanger casings made possible by Grinnell's patented precompression, reduce bulk shipping weight and required headroom by eliminating undesirable height. Installation is simplified by this shorter casing and also by an integral load scale with load indicator.

Additional headroom is saved by a correspondingly shorter turnbuckle. These precompression advantages are available in short spring and double spring models as well as standard spring models.



Refinery piping supported safely, with ample flexibility but low headroom.

## Available in 63 standard units

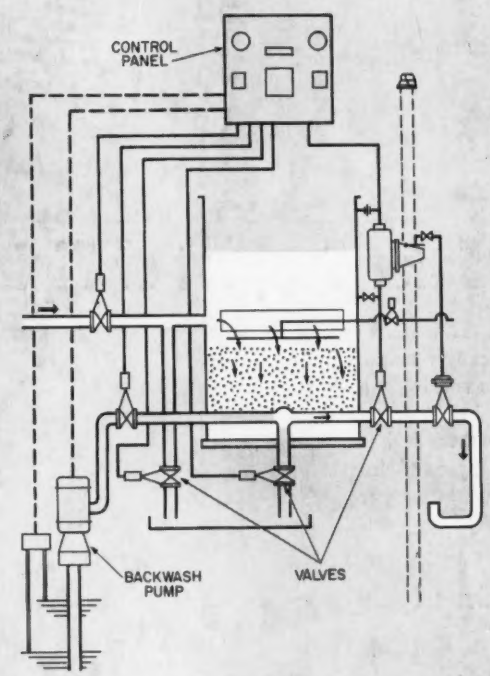
Grinnell Variable Spring Hangers are available in 21 sizes each of short, standard and double spring models . . . for maximum travel of 1¼, 2½ and 5 inches respectively within working load ranges. Load capacities extend from 43 lbs to 30,550 lbs. The maximum variation in the standard size per ½-inch deflection is 10½% of rated capacity; inversely proportional in short spring and double spring models.

## For further information

If you have a pipe suspension problem, you are invited to write: — Grinnell Company, Inc., 278 West Exchange Street, Providence, R. I.

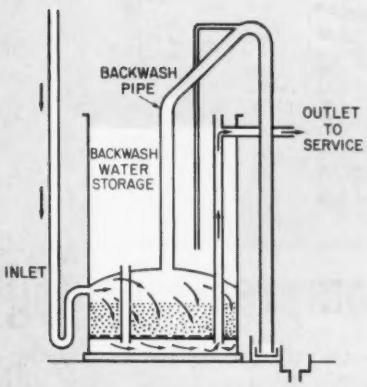
**CONVENTIONAL gravity filter and hydraulic controls for automatic operation. Approximate installed cost of a unit that will filter 500,000 gallons per day:**

**$21,700.00**




**NEW PERMUTIT VALVELESS Gravity Filter. Completely automatic operation. Approximate installed cost of a 500,000 gpd unit:**

**$11,900.00**




**HOW IT WORKS: As dirt collects on the sand, increased head pressure slowly raises the water level in the large backwash pipe. See diagram. When it spills into the downward section of the pipe, it starts a siphon (backwash) flow that draws water down from the Storage area and up through the sand, "floating" dirt off to waste. When backwash water is gone, air enters the small tube and stops the siphon. Flow through the sand reverses and the first filtered water (rinse water) goes to Storage area until full. All flow then runs to Service.**

# *New Valveless Water Filter Saves $$ for Industries, Cities, Electric Companies*

• Big water users like city water departments, steam stations, refineries, chemical plants and paper mills can substantially reduce the cost of their water-conditioning equipment and its operation and maintenance . . . by adopting a new automatic Valveless Filter developed by engineers of the Permutit Company (N. Y.).

The simplified design makes ingenious use of the siphon and other hydraulic principles to replace expensive valves, flow controllers, pumps and hydraulic or pneumatic control systems. The design also prevents wasteful, excessive use of water for backwashing or rinsing. Tanks are shipped set-up to reduce installation costs. The absence of moving parts virtually eliminates maintenance costs.

The Valveless Filter produces uniform, high-quality water. It cannot be "forced." Backwashing or rinsing cannot be too little or too late . . . or accidentally run to Service. And the filter cannot develop common troubles like "cracked" or "upset" beds, "channeling" or "mudballs."

Single Valveless Filters or multiple units for any volume requirement are available. Present installations include units for industrial plants treating water for both process and drinking.

Send for free descriptive bulletin. Address: The Permutit Company, Dept. P-8, 330 West 42nd St., New York 36, N. Y. or The Permutit Company of Canada, Ltd., Toronto 1, Ontario.

**PERMUTIT®**

*rhymes with "compute it"*

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